23 MARCH 1951

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MEAT is a topical subject and Meat by Air is not only topical but a practical method of increasing supplies. Any Cargo can be transported by Air with advantage when a Freighter such as the "Universal" is available to operate anywhere in the World—it is *not* dependent upon extensive and lavishly equipped bases.

About Aluminium... 2

ALLOYS

In this series of articles we deal very briefly with those characteristics of aluminium that are important to the student, believing that although the light metal is now second only to steel in structural significance, its nature and behaviour are not, perhaps, correspondingly known.

CHEMICALLY pure aluminium is soft, ductile and of little structural value but, as extracted, it normally contains up to ½% impurities, mainly iron and silicon. These have a marked effect on the properties of the metal, so that, with the further hardness acquired during rolling, "commercial purity" aluminium has a useful degree of strength and is widely produced in sheet form.

In the early years, however, casting was the principal outlet for the metal, and, without the benefit of work-hardening, strength and good foundry characteristics were sought by alloying, which was soon applied to the wrought forms. Alloying in itself provided a moderate improvement in properties, but the discovery, about 1909, that heat treatment could raise the strength of certain alloys far more than could work-hardening, while retaining a fair ductility, marked the real entry of aluminium into the structural field. This treatment was applied to rolled, extruded and cast alloys, enabling them for the first time to compete with structural steel on a strength basis. Today, a wide range of alloys is available to meet the varied needs of industry, each having been developed for its particular combination of properties.

The alloying elements that are now used include copper, magnesium, silicon, manganese, zinc, and nickel; chromium, titanium, cadmium, columbium, cerium, tin, lead and other metals are also employed in small quantities. The effect of these additions is generally to increase the strength and decrease the ductility of the commercially pure metal, but ease of fabrication, corrosion-resistance, and other characteristics are affected by their presence, singly or in combination.

The composition suitable for a wrought (rolled, extruded, or forged) aluminium alloy seldom fits it for casting, owing to the completely different conditions of manufacture. Casting alloys have therefore developed along separate lines, and it will be found that all aluminium fabricators offer these two main groups of alloys, wrought and cast, with distinct nomenclature systems.

Wrought Alloys

There are two major classes of wrought alloys. In the first, strength is invested by the work-hardening that results from distortion of the structure of the metal during the mechanical shaping processes of manufacture. In this class are commercially pure aluminium and the alloys containing, singly or in combination, manganese, magnesium and silicon. The desired degree of strength and hardness is achieved by controlling the amount of working during fabrication, and the metal can be fully or partly softened at any stage by annealing (at 350 – 400° C).

Work-hardening alloys can be given quite high strength (especially those with high magnesium content) and are generally cheaper than those requiring heat treatment. They are used for building and other constructional purposes, in hollow-ware, in packaging, and in general sheet metal work.

In the second class are the heat treatable alloys, in which copper, magnesium, zinc and silicon are important constituents. These alloys make it possible to use aluminium in many instances where the work-hardening type would not do. Some loss of ductility is inseparable from a gain in strength by cold-working, so that the more fully strain-hardened materials will not tolerate much forming but the temporary softness of the heat treated alloys gives an opportunity for severe forming with assurance that the full properties will be attained before the part is put into service.

Casting Alloys

Satisfactory casting in aluminium demands that the metal should flow readily to all parts of the mould; that, on solidifying, high shrinkage and low hot-strength should not produce fractures; and that the cast structure should be sound. These considerations decide the choice of alloying constituents as much as do strength requirements. Silicon is used in some alloys to enhance the castability and to reduce thermal expansion in service (important in pistons); copper, magnesium and the other elements are used, singly or in combination, to develop particular characteristics, such as susceptibility to heat treatment, good high temperature properties, and corrosion resistance.

Although it has been possible only to outline the complex subject of alloying, it will be seen that aluminium is largely dependent on this technique for its engineering value and that the choice of the right alloy for each task is very necessary. The third article in this series will be concerned with heat treatment.

MAIN ALLOYING ELEMENTS	CHARACTERISTICS OF GROUP	AN EXAMPLE OF THE GROUP WITH ITS TENSILE PROPERTIES			
		NORAL Designation	0.1% Proof Stress tons sq.in	Ultimate Stress tons sq.in	Elongat'n % on 2 in.
WROUGHT ALLOYS					
Mn 1 to 1½%	A work-hardening alloy in wide use for building, packaging and hollow-ware.	3S ¼H 1¼% Mn	8½	9½	9
Mg 2 to 7%	Strong, tough, work-hardening alloys; exceptional corrosion resistance.	A56S ¼H 5% Mg	17½	22½	11
Cu 1½ to 5% Mn ½% Mg ½ to 2% Si ½ to 2%	Heat treatable, widely used in aircraft and other stressed structures. Fair corrosion resistance, often improved in sheet by coating with pure aluminium (Alclad).	26S WP 4½% Cu ½% Si ½% Mn ½% Mg	26	31	9
Mg ½ to 1% Si ½ to 1%	Heat treatable, less strong than the copper group but easier to produce and form. Better corrosion resistance.	51S WP 1% Si ½% Mg	18	20	13
Zn 5 to 7% Mg 2 to 2½% Cu 1 to 2%	Heat treatable, difficult to produce and confined to aircraft and other structures demanding the highest possible strength/weight ratio.	C77S WP 7% Zn 2% Mg 1½% Cu	38	42	11
CASTING ALLOYS (Chill-cast test bars)					
Si 5 to 12%	Easily cast with good pressure-tightness, and heat treatable when magnesium is present.	12S WP 5% Si 1¼% Cu ½% Mg	16	19	2
Cu 4 to 10%	Heat treatable alloys with good machining properties.	22S WP 4½% Cu	24	27	5
Mg 1½ to 10%	Exceptional corrosion resistance, shock resistance, and machinability.	35O W 10% Mg	13	21	18

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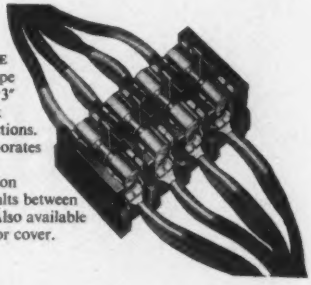

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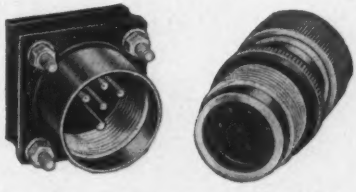

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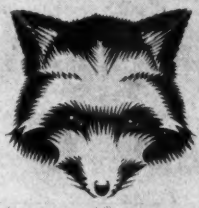

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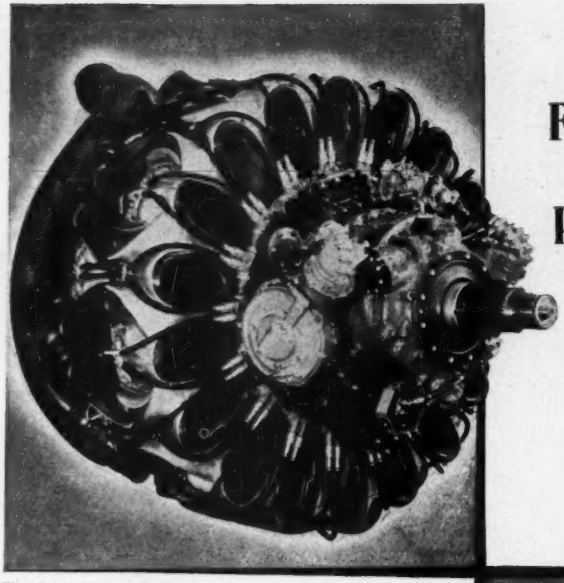

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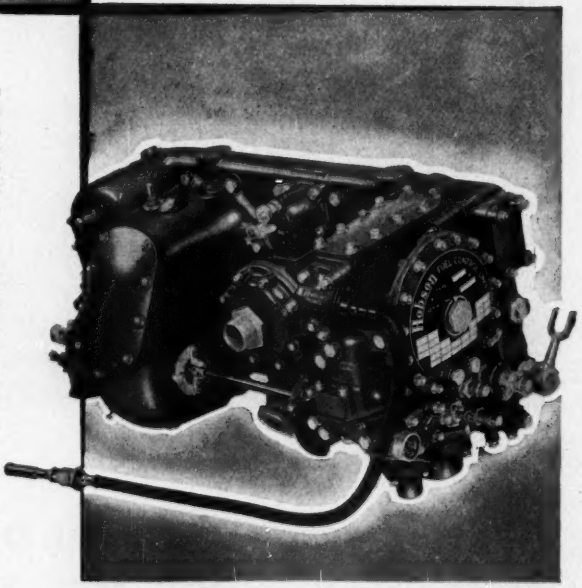

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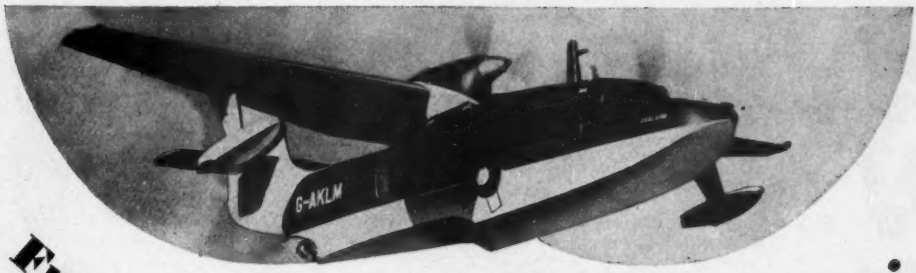
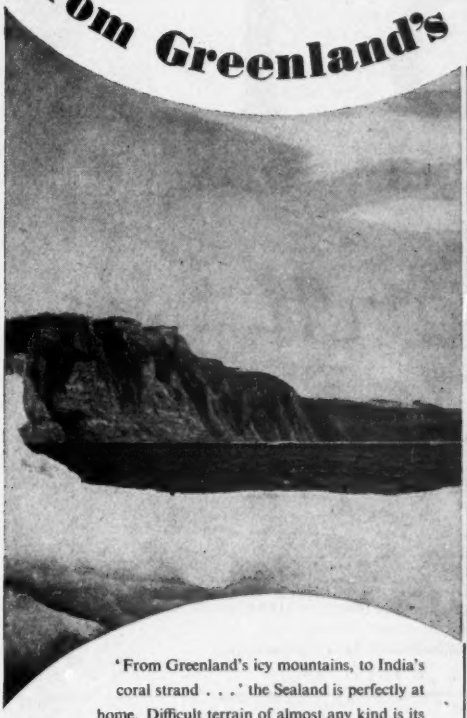
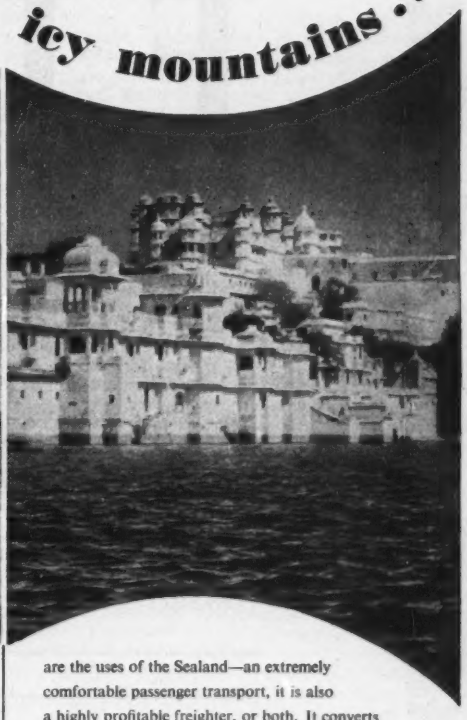


From Greenland's icy mountains . . .





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History Repeated

ONE most striking fact which emerges from the recent pronouncements on R.A.F. re-equipment is that the programme in hand runs closely parallel with the Expansion Scheme prior to 1939. Under that scheme Bristol Blenheims, and the Mercury engines for them, were ordered in great numbers from several factories : to-day the English Electric Canberra and the Rolls-Royce Avon provide almost exact counterparts. To pursue the analogy, the Blenheim first served as a light bomber, but was later developed for reconnaissance, fighting and intruding—roles for which the Canberra is obviously a "natural." Of the newest types of fighters on order nothing specific can yet be said; but the Hawker and Supermarine swept-wing prototypes might reasonably be expected to sire new standard single-seaters which, in the pattern of re-equipment, would correspond with the immortal Hurricane and Spitfire.

Just as the Canberra may be considered as the Blenheim of to-day, so a counterpart of the Wellington may be imminent, and no one would be surprised if American reports of a new Vickers jet bomber were soon substantiated. Then, logically, big multi-jet bombers from Handley Page and Avro should follow, in the tradition of the Halifax and Lancaster. For general-reconnaissance duties the Anson was one of our standard pre-war types, and to-day the Shackleton, by the same makers, will serve in a similar capacity. Even more remarkable is the news that the American Lockheed Hudson, one of the mainstays of Coastal Command in the early war years, is to have an R.A.F. successor in the Neptune.

That an old pattern is again unfolding is no reason for concern: far from it, for the salutary lessons learned by the industry and the Service more than ten years ago have not been forgotten. And if—as we certainly have no cause to doubt—the new machines render as good an account of themselves as did their forebears, we may indeed be thankful.

Speeding the Helicopter

AFTER many years of neglect, the helicopter is now receiving something like its fair share of attention, and constructors are developing a wide variety of new designs for divers duties. General interest has recently been stimulated by a number of happenings: the exceptional rescue work of helicopters in Korea; the announcement of the tiny ram-jet Hiller Hornet, which holds out a possibility in the future of becoming the basis of an aerial minicar; the announcement of Britain's first twin-engined commercial helicopter, the Bristol 173; and the adoption by the Navy of ship-borne Westland-Sikorsky Dragonflies for A.S.R. and communications.

To the ordinary air traveller the helicopter is still a relatively unknown quantity which seems to have certain convenient qualities from the transport point of view, in particular the ability to hover and land with no forward speed, and thus arrive at, or take off from, very small sites in built-up areas. The more knowledgeable of air travellers will also associate these qualities with additional safety, knowing that—good as the record of the world's airline operators may be—of the mishaps which do occasionally occur the largest percentage, by far, falls under the heading of landing accidents.

While the makers of conventional airliners strive to hold down take-off and landing speeds as top speeds and wing-loadings increase, the designers of helicopters, having achieved hovering flight, seek means of increasing cruising speed. Helicopters cannot, as yet, fly fast. For economical commercial operations (and with the possibility of strong head-winds) the block speeds which can be achieved at present are too low.

Bearing in mind these contradictory speed requirements of modern transport aircraft, the views of Captain R. N. Liptrot on the intriguing subject of convertible aircraft, expressed in his lecture before the Royal Aeronautical Society last week-end, are of absorbing interest. After discussing possible configurations and capabilities of convertible aircraft, Captain Liptrot came to the conclusion that the combination of a helicopter system with small fixed wing was a relatively simple but extremely effective device for raising the operating speed of the aircraft, making real convertibility unnecessary where speeds of the order of 250 m.p.h. were sufficient. Thus, we may next expect to see the marriage of the rotating-wing aircraft with the fixed-wing type.

PUTTING SOME BEEF INTO IT

Australia's Daily Meat-run in Action: A Freighter Pilot Describes his Day's Work

As told to JOHN W. R. TAYLOR

IN these days of eightpenny meat rations, it is not surprising that even the popular Press has shown interest in the Australian "Air Beef" scheme. Naturally enough, the emphasis has been on the meat itself, and nobody seems to have given a thought to the pilots who have had the task of flying Bristol-Freighter-loads of frozen fore-quarters from Glenroy to Wyndham for months on end.

We were therefore delighted a few weeks ago to meet one of the original "Air Beef" pilots and, over a pint or two or three, to persuade him to tell us something of his experiences on the meat runs. Half of what he told us follows; the other half, richly garnished with Australia humour, was even more amusing!

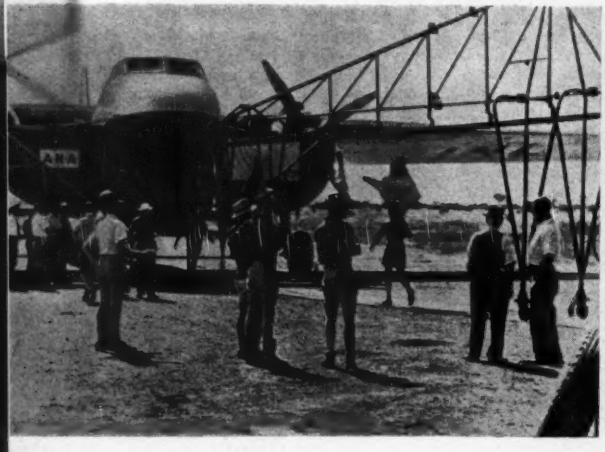
I was never (he reminisced) very impressed by advice about being "early to bed; early to rise"; so when, at 4 a.m., the alarum by Capt. "Sturdee" Jordan's bed started to clang, I usually got out of bed, blundered over and turned the damn thing off, then dashed back to bed. Outside, it was always as black as the ace of spades and cold as charity. About 4.15, when we could delay no longer, we got up and dressed in shoes, stockings, khaki shirt and shorts, jersey and greatcoat, before moving to the next bedroom to dig out the engineer and a cleaner. They merely slipped trousers and a greatcoat over their pyjamas, so that they could go back to bed after we had taken off.

Then we moved off to Wyndham airfield in a 15-cwt utility, with the lucky two in the cab warm, and the other two grousing and cold in the back. At the field, we swopped grunts with the Aeradio operator (another pyjamas-and-greatcoat type) and then staggered out to the aircraft. First job was to give her a visual inspection, remove the control locks, drain some petrol from the tanks to check for water, pull the props through and, after the rest of the palaver, hop in and get her going. Still utter darkness and plenty cold.

A GOOD deal has been printed, both in "Flight" and elsewhere, about the "Air Beef" transport operations run by Australian National Airways: but in presenting this article we make no apology for returning to the subject, because the angle from which the story is told is an original one and its style is unusually entertaining.

Half a dozen "gooseneck" kerosene flares lit the runway, and we had to bore our way down this in the dark and climb as rapidly as we could to get above the surrounding hills. In the empty Freighter this was quick and easy. A short call on the radio to the Wyndham Aeradio man, giving our time of departure, expected time over Karungee (a homestead with a landing ground about half-way to Glenroy), and E.T.A. at Glenroy. Then we settled down in silence to the top of the climb.

Sturdee and I were very good friends and got on well, and this pre-breakfast taciturnity was the silence of good friends keeping quiet while their respective livers woke up and gradually got rid of their morning quota of saltiness. By this time, there would be yet another superb purply-red sunrise, which was watched by us with the same indifference as on



The nose-doors of the Freighter facilitate loading of the carcases.

Five months' operations summed-up in statistics painted on a Freighter.

(Left) "Mannana", an A.N.A. Bristol Freighter employed on the beef run, seen at Essendon Airport, Melbourne, after returning from Glenroy at the end of the meat-transport season. (Above) Quarters of beef move along the conveyor from the Glenroy freezing-chambers to a Freighter.

umpteen previous mornings. The sunrises and sunsets were so consistently beautiful that after a while they didn't mean a thing except that one indicated a whole day ahead and the other that "cease work" and a cool drink were not far away.

By the time we reached Karungee the sun was always well up, so we shed our jerseys and were down to shirt, shorts, stockings and shoes. Over Karungee, we signed-off Wyndham Aeradio and contacted the operator at Glenroy, signalling time over Karungee, height, flight conditions and E.T.A. Glenroy. He acknowledged and passed on any abnormality about the Glenroy field and weather. As we passed each landmark we mentally checked our progress for track and ground speed, but the route was so short and the weather so consistently good that the trips never varied by more than five or ten minutes. The average flying-time was 1¼ hr.

Out at Glenroy, work started at about the time we left Wyndham, so that by the time we arrived enough half-beasts had been quartered in the freezing-chambers to make up a full load for us to carry back to Wyndham.

After landing, we taxied to a marked spot on the strip and cut the motors. As soon as this was done, a gantry carrying a monorail was swung out towards the freighter so that the quartered carcases could be pushed out of the freezing-chambers to within 30ft of the aircraft. Loading was started immediately, the quarters of meat being carried from the end of the monorail by a loader who trotted up an inclined ramp and dumped them just inside the machine on freshly-scrubbed canvas, whence they were manhandled up the floor of the cabin by two men and then stacked and tied down with plastic-covered ropes.

While all this was happening, Sturdee and I dashed over to the mess for a breakfast of damper [a native form of bread, made without yeast and baked in ashes], black tea, and beef. One beast a week was allocated to the mess and it was eaten from tail to nose for breakfast, lunch and dinner every day of the week. You'd be surprised just how much there is in a plain ornery old bull that doesn't come under the heading of tender steak!

After breakfast, I examined the load for security while Sturdee checked the documentation and aircraft. Then we clambered up the rickety ladder, through the small forward door, and were soon off again with 9,000 lb of frozen beef. By this time we were down to shorts and sandals only—shirts and stockings were for cissies, high days and holidays, or for when any V.I.P. came up from the Big Smoke (Perth) to see what wasn't going on and why not.

Back at Wyndham, a big six-ton insulated truck was backed up to the aircraft as soon as we landed, and unloading started. At the same time, the aircraft was refuelled from an underground storage-tank. Sturdee and I made a habit of wandering over to the Aeradio office at this stage, to get in the operator's hair and bludgeon a cup of tea out of him. This was always ready on time, as he put the electric kettle on as soon as he received my call: "I'll be landing in 10, what are your landing instructions?"

After the tea and a smoke, we found the Freighter ready and refuelled, so we went out and started the business all over again—confirming that the stores for Glenroy were securely lashed in the cargo-hold and correctly disposed for weight and balance, checking fuel, documentation, and so on and so forth; then off into the blue again.

By now the flying conditions were usually pretty turbulent and we had to bump our way back to Glenroy. There, killing would be well under way and another load of 24-hour frozen beef cut down and waiting for us. This time, if we didn't have to help load the beef, we usually shot over to the outdoor shower near the killing floor for a swill down. Then, with another full load, we once more pounded down the strip and set course for Wyndham.

The run available was about 6,000ft of earth—red, solid, hard as concrete and flat as a billiard table. All you need to make a landing strip in that part of the world is to find a level spot, pull out the bushes and run a grader over the ground to remove small ant hills and tussocks, and there she is, as good as any concrete runway, at a total cost of about £100. Not so good when it rains, perhaps, but it just doesn't rain during the "Air Beef" season—I saw three small cotton-woolly clouds the whole time I was there.

An aircraft taking off raises a lot of dust, but unless it is blowing towards the camp it doesn't matter, as there is never anybody around to care except a stray mob of cattle being brought in to Glenroy, and they have only another 24 hours in which to worry, anyway.

This trip to Wyndham would be our fourth run over the route for the day and our second load into Wyndham. After it, we always had lunch in a nearby pub if we were on time; if not, a cold lunch was brought to us at the airfield. In the afternoon, we did another round trip and got back to Wyndham just before sunset, by which time the unloaders at Wyndham would be on overtime rates and hoping we'd be late, and the Glenroy boys would be finished for the day. The Freighter was serviced during the evening and night, a routine which included washing-down the cabin, the floor canvasses and tie-down ropes.

Part of the time we operated from the Glenroy end and, during this period, enjoyed all the curses and pleasures of Boy Scout life on a man-sized scale. Three times a week there was a 16 mm film show, made up alternately of "educational" films and normal movies. It seems there is more educational than purely entertainment stuff available on 16 mm! The camp's population fluctuated between 15 and 25 at this time, and one and all dragged round beds, boxes or whatever they decided was most comfortable to sit on. The "goodies" in the films were cheered, the "baddies" roundly booed and hissed, and the "frails" loudly approved in brief, succinct Aussie terms. Fortunately, the only woman in the camp—Diana, a full-blooded aborigine—couldn't speak or understand a word of English.

For those who wanted it, there was a daily ration of one bottle of beer—and this on no moral grounds, but merely because up there it cost a lot and had to be flown all the way from Perth. Strangely enough, among men noted for their toughness and, under city working conditions, great capacity, no one in the camp ever wanted more than his one bottle.

Other than the movies, the main pastimes seemed to be growing a beard and shooting. Most of the fellows grew large and fierce-looking beards, and when they were on the killing floor, and covered with blood and sweat, they really did take on a plundering, vandal look which completely disguised their enthusiasm and good humour. There was the usual amount of honest grousing that you get among any bunch of similarly placed men, but there never was a fight or bad dispute all the time I was there, except for one man who turned it in because he thought that £23 a week was not enough return for cooking for the camp.

Everyone was prepared to turn his hand to anything. Tell a slaughterman in the city that: "There's no killing to-day, go paint the freezer roof," and you'll get a highly descriptive reply. Or tell a city clerk to go and mix concrete and see what he says. But at Glenroy everybody wanted to see "Air Beef" succeed, especially as there were plenty of outsiders who wished the project ill-luck. There were initially shortages of this and that. The diesels gave trouble, the freezers wouldn't freeze; but overall there was a terrific *esprit-de-corps* and a bull-headed determination to see "Air Beef" succeed and make the gloom-and-doom merchants eat their words. I'm sure there must be a moral in that somewhere, but I'm hanged if I can find it.

FROM ALL QUARTERS

South-East Asia, 1943-44

A DISPATCH, submitted to the Secretary of State for Air on November 23rd, 1944, by Air Chief Marshal Sir R. E. C. Peirse, K.C.B., D.S.O., A.F.C., Allied Air Commander-in-Chief, South-East Asia, and entitled *Air Operations in South-East Asia, 16th November, 1943, to 31st May, 1944*, has been issued by H.M. Stationery Office as a supplement to the *London Gazette*. A set of maps to illustrate the dispatch is on separate sale at 1s. net. These maps also cover the operations described in the Air and Army dispatches of the Burma campaign from November 16th, 1943, to September 12th, 1945.

Canberra makes Friends

WE have just heard from Mr. Arthur W. Perkins, Editor of the *Martin Star*, house journal of the Glenn L. Martin Company, that the Canberra is making an excellent impression at Baltimore. He writes: "The Canberra has been at our airport for a week and it has been a real pleasure to go over the airplane structurally and to see its performance. Wing Commander Roland P. Beamont, English Electric's chief test pilot, has been here several days and given superb demonstrations of the Canberra's capabilities in the air. The simplicity of its construction has been a revelation, too."

A Marathon for Africa

WITH fitting ceremony and a host of good wishes from the company assembled to witness the occasion, the first Handley Page Marathon to go into regular service as a "junior airliner" was handed over to the chairman of the West African Airways Corporation, Sir Hubert Walker, on Wednesday, March 14th, at the manufacturers' airfield at Radlett.

Before the ceremony, the Marathon—attired in the green and gold of W.A.A.C.'s livery, and fitted with 18 seats for high-density traffic in West Africa—carried a full complement of passengers on a demonstration flight. Among them were Sir Hubert and Lady Walker and a number of the West African company's officials. A member of *Flight's* staff who was on board noticed the favourable impression created among the other occupants by the quick take-off at full load and excellent rate of climb: in fact, the general consensus of opinion seemed to be that the Marathon would prove popular on the Corporation's tropical routes.

At the subsequent ceremony, in which Sir Frederick Handley Page handed the C. of A. to Sir Hubert Walker, it was announced that the Marathon was to fly on W.A.A.C. routes for a trial period of three months so that the company could obtain service experience of the new aircraft before finally committing itself to a decision on fleet re-equipment.

The following morning, under the command of Capt. R. Hallam, West African's chief pilot, the aircraft left on the first leg of its 3,500-mile flight to Lagos, Nigeria.

It is understood, incidentally, that work is going ahead at full speed on the batch of Marathons which is being prepared for service on B.E.A.'s Scottish and Channel Island routes.

Wrights and the Sapphire

LARGE orders have been received from the U.S.A.F. for the Armstrong Siddeley Sapphire turbojet built by the Wright Aeronautical Corporation. The Sapphire—designated J-65 by the American Air Force—flew in a Republic F-84F Thunderjet fighter for the first time on February 14th. Mr. Roy T. Hurley, president of the Curtiss-Wright Corporation and its aircraft engine division, the Wright Aeronautical Corporation, has stated that Wright are carrying out a development programme to increase the Sapphire's performance beyond the 7,200 lb. thrust now delivered. He confirmed that the Sapphire "uses fewer critical materials than any other of its type." Mr. Hurley said that the engine will add extra "punch" and range to the F-84F Thunderjet. "Installation of the Sapphire in the F-84," he said, "brings to a battle-tried airplane a proven engine which will extend every point of the plane's performance." The increased power of the Sapphire, its greater fuel economy, and its improved ratios of frontal area and weight to output will increase even further the already outstanding performance of this versatile fighter.

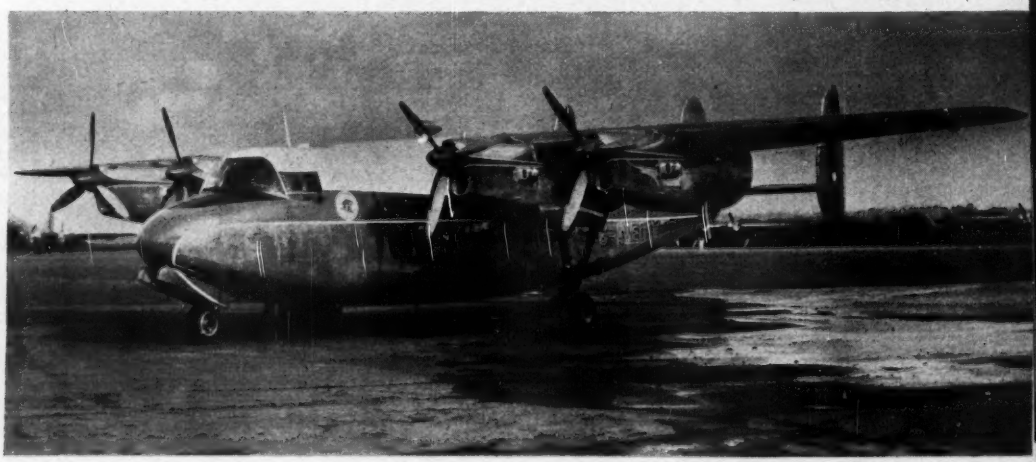
It is known that the F-84E, predecessor of the "F," has a top speed of "over 600 m.p.h.," a combat radius of 1,000 miles with external wing tanks, and a service ceiling of more than 45,000 ft.

To meet production demands for the J-65 Sapphire and for piston engines, Wright increased their staff from approximately 7,000 to almost 10,000 in 1950, and will probably double the number this year. It is also planned to spread overflow work by sub-contracting and by licensing automotive and other qualified manufacturers to build Wright engines.

Responsibility—by Admiral Cunningham

SPEAKING at the recent annual dinner of the Institution of Naval Architects, the president, Admiral of the Fleet Viscount Cunningham of Hyndhope, commented on the serious position the Admiralty is facing because of the shortage of naval constructors to carry out its rearmament programme. He criticized the theory that men will work more cheerfully for the State than for the private employer, saying that there had been too much mischievous teaching about "rights." The whole conception of life and activity in a "Welfare State"—or any other for that matter—had become lopsided and out of balance. Many of our countrymen needed to show a much higher sense of duty, and display a greater degree of moral courage, if they would play fair with the rest of the community. It was only too true that State

AFRICAN EMIGRANT: As reported on this page, the first model of the Handley Page Marathon to be placed in regular airline service left last week on a 3,500-mile flight to Lagos, Nigeria, where, as an 18-seater, it is to undertake route trials with the West African Airways Corporation.



control could too readily induce a sloppy acceptance of the average or even of the second-rate. Every encouragement, therefore, needed to be given to men who showed they could personally rise above such standards.

"Otherwise," said the Admiral, "we shall assuredly decline in workmanship and craftsmanship in the next generation, and our industrial leaders of the future will find themselves quite unable to compete with their opposite numbers in other countries." It was distressing, he continued, to read of stoppages caused by men indulging in petty recriminations as to whether a certain job was some particular person's business or not. What would men say if the Press reported the loss or damage to one of His Majesty's ships in a fog, which, it could be shown, was caused by a dispute between a signalman and a seaman look-out as to whose job it was to report the sighting of rocks ahead?

Greek Airlines to be merged

IT has been announced by the Greek Prime Minister, Mr. S. Venizelos, that the three Greek airlines are to be merged with effect from July 1st. They are T.A.E., A.M.E., and Hellenic Airlines. The merger is designed to effect economies in administration and other expenditure, and will be accompanied by a reorganization of existing timetables. T.A.E. has received financial backing from Trans World Airlines, and Scottish Aviation, Ltd., is financially interested in Hellenic.

Convertible Aircraft

LECTURING on "Convertible Aircraft" at a joint meeting of the Royal Aeronautical Society and the Helicopter Association in London, on March 17th, Capt. R. N. Liptrot, C.B.E., B.A., expressed the view that "the lower the degree of convertibility, the better are our chances of success." Capt. Liptrot described several possible "convertible" configurations, and recalled the Herrick "Vertoplane" of 1937. "I would say that from now onward," he told his audience, "every helicopter design should have small wings, or at least provision for adding them during development, since the advantages they confer are so outstanding."

A report of Capt. Liptrot's unusually interesting paper will appear in a forthcoming issue.

Brabazon for the Paris Show

IT is learned from France that on the occasion of the 19th Salon International de l'Aéronautique—which, as already announced, will take place between June 15th and July 1st—the Bristol Brabazon will make its first flight outside the British Isles. It is intended that the Paris Show this year shall be rather more elaborate than in the past, and a large number of aircraft which cannot be accommodated in the Grand Palais,or are intended for flight demonstration, are to be assembled at Le Bourget. It is to this airport that Mr. Pegg is expected to take the Brabazon.

METEORS IN THE MAKING at the new Schipol works of the Fokker Company. Dutch production of Gloster Meteor 8s for the Benelux Countries is to be supplemented by assembly of British Meteor components in Belgium by Avions Fairey.

Four-jet B-47

A DEVELOPMENT of the Boeing B-47 six-jet bomber—designated B-47C—is powered with four Allison J-35-A23 jet units, delivering greater thrust than the six General Electric J-47s at present installed in Stratojets. The standard J-47 delivers about 5,200 lb thrust, whereas the J-35-A23s are expected to produce nearly 10,000 lb apiece.

Viscounts for Air France

AS we go to press we learn, with considerable gratification, of an order which was announced by Air France last Monday—for six Vickers Viscounts. It is understood that these machines will be introduced on the company's London-Paris route, where, incidentally, they will be in direct competition with aircraft of the same type which are to be operated by British European Airways.

Delivery of the first machine of the order is expected in early 1953, shortly after B.E.A. take over their own first Viscount.

ANGLO-AMERICAN CONFERENCE

DURING a ten-day visit to New York in January, Capt. J. Laurence Pritchard, retiring Secretary of the Royal Aeronautical Society, discussed with officials of the Institute of the Aeronautical Sciences the arrangements for the Third Anglo-American Aeronautical Conference, to be held at Brighton from September 3rd to 7th.

The R.Ae.S. has now announced some details of the arrangements, and issued a provisional list of the ten American and ten British papers which will be read. Only members of the R.Ae.S. and/or the I.Ae.S. will be admitted as delegates to the Conference, which will take place at the Grand Hotel, Brighton. The lectures will be delivered in the mornings and afternoons of the period Tuesday, September 4th, to Friday, September 7th, starting at 9 a.m. each day. In addition to the technical sessions, arrangements are being made for delegates to visit places of interest, including the 1951 Exhibition, and to attend special evening functions. Following the Conference, opportunities will be given to the American delegates to visit aircraft firms, and to attend the S.B.A.C. Display at Farnborough.

The provisional list of papers is given below.

American Papers

Linear and Non-Linear Aerodynamics of Low Aspect Wing-Body Combinations at Sub and Supersonic Speeds—A. H. Flax and H. Lawrence (Cornell Aeronautical Laboratory).

Structural Problems of Future Aircraft—Nicholas J. Hoff (Polytechnic Institute of Brooklyn).

Aeroelasticity and Flutter—I. E. Garrick (Aeronautical Research Scientist, Langley Aeronautical Laboratory, N.A.C.A.).

Transonic Aerodynamics—John Stack (Assistant Chief of Research, Langley Aeronautical Laboratory, N.A.C.A.).

Dynamic Stability and Control—W. F. Milliken, Jr. (Manager Flight Research, Cornell Aeronautical Laboratory).

Propellers for High Speed Aircraft—George Brady (Curtiss-Wright Corporation).

Flight Safety—J. Lederer (Daniel and Florence Guggenheim Aviation Safety Centre, Cornell University).

Jet and Rocket Propulsion—L. Dunn (California Institute of Technology).

High-speed Hydrodynamic Development—E. G. Stout (Consolidated Vultee Aircraft Corporation).

Jet Efficiencies—George Schairer (Boeing Airplane Company).

British Papers

Advances in Aircraft Structural Design—G. T. R. Hill (Sometime Professor of Mechanical Engineering, University College, University of London).

Reduction of Drag by Distributed Suction—Prof. Sir Bunnett Melvill Jones (Francis Mond Professor of Aeronautical Engineering) and S/L. Head, R.N.Z.A.F.

Influence of Size on the Performance of Jet Engines and Some Estimates of the Resultant Effects on Aircraft Performance—S. J. Moyes and W. A. Pennington (National Gas Turbine Establishment).

Flight Development of Thick Suction Wings—L. P. Coombes (Chief of the Division of Aeronautics, Council for Scientific and Industrial Research, Australia).

Some Aerodynamic Advances—A. Fage (Superintendent of the Aerodynamics Division, N.P.L.).

Engineering Problems of Aircraft Operation—B. S. Shenstone (Chief Engineer, B.E.A.).

Aircraft Structures—A. H. Hall (Research Officer, Structures Laboratory, National Research Council, Canada).

Some Problems of Turbine Transport Operations in Europe—K. G. Wilkinson (Project and Development Branch, B.E.A.).

Plastics and Plastic Structures—J. E. Gordon (Principal Scientific Officer, Chemistry Department, R.A.E., Farnborough).

Material Properties for High Altitude Operation—Dr. T. P. Hughes (Senior Principal Scientific Officer, Head of Chemistry Department, R.A.E., Farnborough).

HERE AND THERE

Stratojet Flight-refuelled

USING the "boom" method of transferring fuel, a B-47 Stratojet bomber successfully completed flight-refuelling tests last month in conjunction with a KC-97 tanker. The tests were an all-Boeing affair—this company designed the refuelling system used, provided the crews and designed both the bomber and its tanker, a military version of the Stratocruiser.

Offensive A.O.P.s

SUCCESS achieved in Korea by liaison aircraft—known as air observation posts in the R.A.F.—has encouraged U.S. Army experiments in using light types for offensive purposes. During trials to date, a Stinson L-5 Sentinel has been successfully used for bombing (carrying loads of up to two 300-pounders) or firing four 5in rockets. Another experiment on the same lines was the installation of a 75-mm "bazooka-type" rocket-launcher at each wing-tip of a Stinson L-16.

A.S.R. Dragonflies

THE adoption of Westland - Sikorsky Dragonfly helicopters for air/sea rescue and communication duties between ships of the Fleet is officially announced. The first is now embarked on the Fleet carrier *Indomitable*, flagship of Admiral Sir Philip Vian, C.-in-C. Home Fleet, and it is intended that all carriers and air stations shall eventually be equipped with these machines. They will be used in place of Sea Otter amphibians, being more suitable for A.S.R. work in that they can hover over a selected position and, if necessary, lower a man to the assistance of imperilled aircrew. The helicopter can also operate in worse conditions than the Sea Otter, which is limited by its inability to land in rough seas; the Admiralty states, in fact, that the helicopter's effectiveness is limited only by very high winds which might prevent take-off from a ship's deck.

SALVO: This dramatic study of a Swedish Air Force Saab-21A fighter (D.B.605 engine) firing a salvo of four rocket projectiles was voted at the annual competition of the Swedish Press Photographers' Association to be the picture of the year.

R.A.F. Rugby

THE Royal Air Force Rugby XV played a drawn game with the Civil Service at Chiswick on March 14th, each side scoring six points. The R.A.F. scored a penalty goal and a try—the Civil Service two penalty goals.

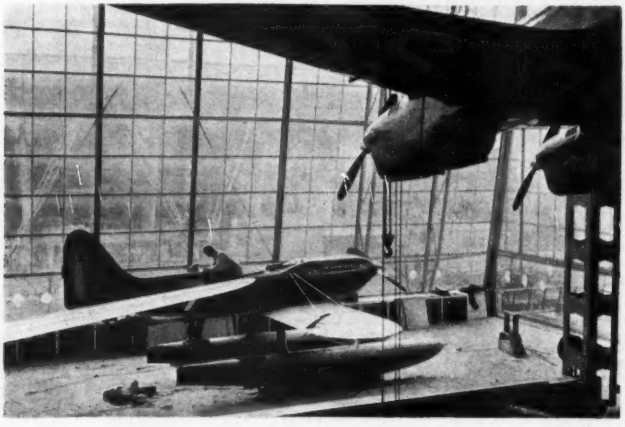
Woman Test-pilot

AN Avro Lincoln delivered to Australia recently was co-piloted by Miss Lettice Curtis, who is believed to have been the first woman A.T.A. pilot to fly a four-engined bomber. Miss Curtis is employed as a test pilot at the civil-aircraft section of the A. and A.E.E., Boscombe Down. Due for leave, she volunteered to fly the Lincoln to Australia with Lt. Cdr. William Stuart, also from Boscombe, to enjoy a brief holiday in the Commonwealth. For two years, Miss Curtis held the 100-km women's speed record (since broken by Miss Jacqueline Cochran of America) of 313 m.p.h. in a Spitfire 12; she is one of the very few British woman pilots to have flown a jet aircraft—an early mark of de Havilland Vampire.

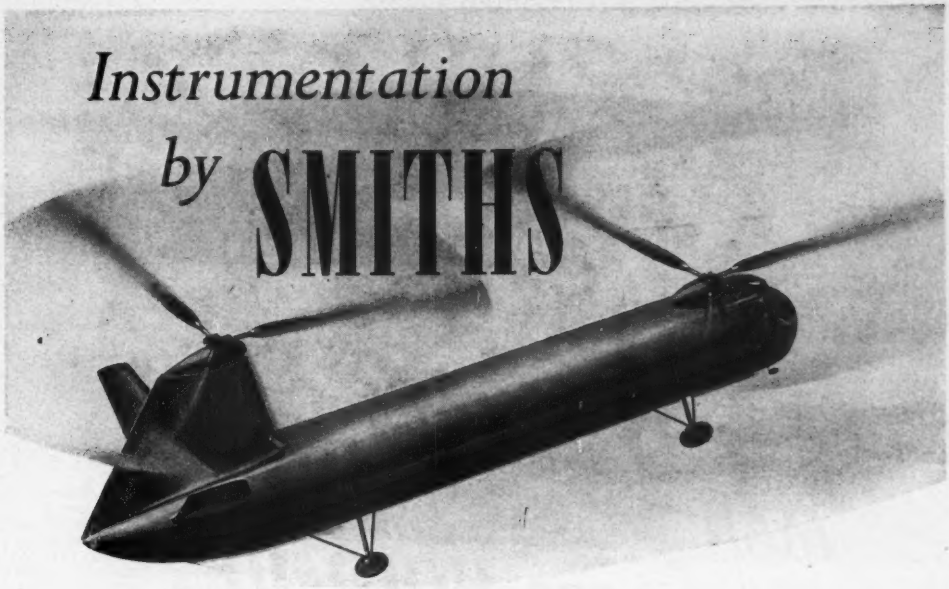
U.S.A.F. Expansion

WHEN the Korean War began, the United States Air Force consisted of 48 groups. It has since been increased to 60, and is being expanded to a total of 95 groups by January 1st, 1953. The strength, in aircraft, of a group depends on its function. Heavy bomber (B-36) groups are 30-strong; medium bomber groups have 35 aircraft—plus, in some cases, 20 flight-refuelling tankers. The composition of other groups is as follows: light bombers, 48; tactical fighter-bomber, 75; day intercepter, 75; all-weather intercepter, 36; tactical reconnaissance, 54; strategic reconnaissance, 30; troop-carrier, 36 or 48.

In the following analysis of the structure of the planned 95-group air force, pre-Korea strengths are given in parenthesis: 6 heavy bomber groups (3); 20 medium



IMMORTAL SPEEDSTERS: The S.6B Schneider Trophy seaplane in which Stainforth raised the world's speed record to 408 m.p.h. in 1931, and the original D.H. Comet in which Scott and Campbell Black reached Australia in under three days in 1934, are moved into place in the South Bank Exhibition (see story on p. 336).



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CANADA, 350 Hillcrest Avenue, Willowdale, Toronto. Phone : Willowdale 3567

HERE AND THERE . . .

bomber groups (12); 5 light bomber groups (1); 18 fighter-bomber groups (9); 11 day intercepter groups (8); 11 all-weather intercepter groups (3); 6 tactical reconnaissance groups (1); 6 strategic reconnaissance groups (5); and 12 troop-carrier groups (6).

French Ejection Tests

TEST-JUMPS with the ejector seat manufactured by the French S.N.C.A.S.O. organization are being made by M. André Allemand. The first test—an ejection at 187 m.p.h.—was made from a Bloch 175 at Bretigny in January; the same aircraft was used recently at Bricy-Orleans for a second jump at 262 m.p.h. Tests at over 500 m.p.h. are to be made from two Meteor 7s.

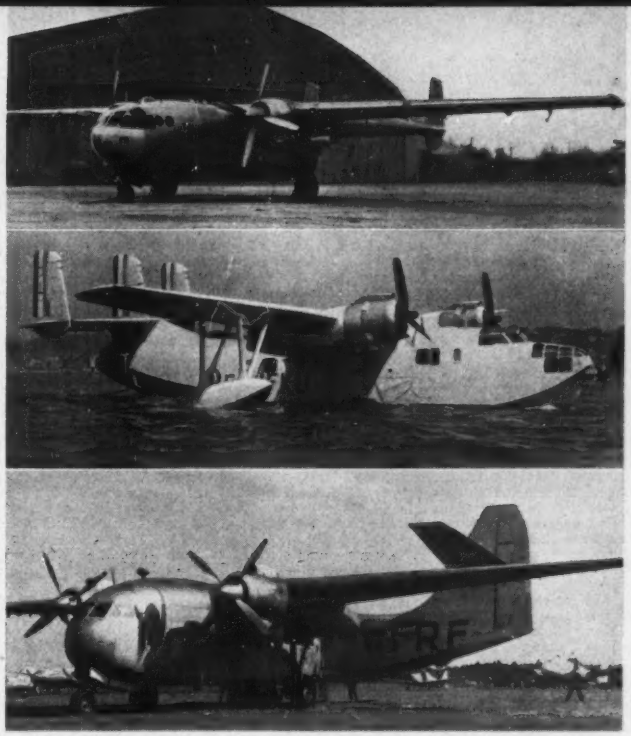
N.Z. Race Prizes

A TOTAL of £29,000 in prizes will be awarded at the conclusion of the 1953 air race between England and New Zealand, some details of which were announced in our previous issue. Prizes of £10,000, £3,000, £1,000 and £500 will be awarded for the first four positions in both sections of the race. In addition, the winner of the speed section will receive the Harewood Gold Cup. The prize-monies will be paid in Christchurch, in New Zealand currency.

France to Build Hercules

AN agreement has been concluded between the French S.N.E.C.M.A. organization and the Bristol Aeroplane Co., Ltd., under which Hercules engines will be built in France. An initial supply of substantial numbers of Hercules from this country is also covered by the agreement. The immediate application will be to the S.N.C.A.N. 2501 military transport, to be built in large quantities; Hercules 758s are specified. Hercules are also installed in the S.N.C.A.N. 1401 flying-boat and the Bréguet 890-H transport.

There has long been collaboration between France and the Bristol company. The "Box Kite" of 1910 was evolved from the Farman biplane. Twelve years later the Gnôme et Rhône company, ancestor of S.N.E.C.M.A., took the licence for the Jupiter, and Mr. Norman Rowbotham, present managing director of Bristol's engine division, supervised construction. A similar task has been performed by Mr. Roger Ninnes, who was largely responsible for negotiating the present agreement.



HERCULEAN FRENCHMEN: All three of these French aircraft—the S.N.C.A.N. 2501, S.N.C.A.N. 1401 and Bréguet 890-H—(with tail folded) are powered with Bristol Hercules engines of the type which is to be built under licence in France (see paragraph on this page).

IN BRIEF

THE British Council is organizing an exhibition of British scientific instruments in Paris in connection with the French Physical Society Exhibition, May 11th-17th. The R.A.E., Farnborough, is contributing five exhibits.

* * *

Research in Industry is the title of a new brochure illustrating and reviewing the work of Tiltman Langley Laboratories, Redhill, Surrey. It lists the wide range of aeronautical design, manufacture and repair work for which the firm is A.R.B.-approved and deals in some detail with such special developments as the Gerritsen gearbox and the company's leakproof pressure-pipe joint. Thermal de-icing, cabin air-conditioning and armament equipment are also mentioned. Mr. Marcus Langley, F.R.Ae.S., A.M.I.Mech.E., F.R.Ae.S., and Mr. A. Hessell Tiltman, B.Sc., F.R.Ae.S., are managing and technical director respectively.

* * *

Bryans Aeroquipment, Ltd., Willow Lane, Mitcham Junction, Surrey, have issued a comprehensive loose-leaf catalogue dealing with their test equipment for aircraft-instrument calibration and maintenance.

* * *

C. C. Wakefield and Co., Ltd., announce that the Castrol head offices in Grosvenor Street, London, W.1, will shortly be extended into the adjacent building vacated by the fashion house of Molyneux.

* * *

The Telcon and Mullard Electronic companies announce the formation of a new company, Telcon Telecommunications, Ltd., to co-ordinate development, manufacture and sales of landline equipment. Offices are at 22, Old Broad Street, London, E.C.2.

* * *

Capt. C. D. Schermuly has been awarded the Order of the Icelandic Falcon by the Government of Iceland in recognition of his contribution to life-saving. He is chairman of the Schermuly Pistol Rocket Apparatus, Ltd., specialists in marine distress equipment and marine and aeronautical pyrotechnics.

HONOURED: S/L. J. C. C. Taylor, R.A.F.V.R., leaving Buckingham Palace after receiving the M.B.E. He is accompanied by his daughter Anne (on his right) and his wife. S/L. Taylor is aviation manager of Shell-Mex and B.P. Ltd.

SOUTH-BANK AERONAUTICS

Details of the "Air Transport" Display at the Festival Exhibition

THOUGH considerations of space at the South Bank Exhibition preclude the showing of many full-scale aircraft, details lately released by the organizers suggest that the "Air Transport" section of the "Transport and Communications" pavilion is likely to present a comprehensive picture of British civil aviation progress.

Visitors approaching the pavilion (a drawing of which appeared in our issue of January 11th) from the west will be able to identify it by an actual 16ft-diameter contra-rotating airscrew which, mounted on an exterior wall, will rotate slowly during the hours that the exhibition is open. Inside, the story will be told by exhibits on the first-floor gallery, and by full-scale aircraft suspended in the large well of the building.

Beginning with Sir George Cayley's design of 1809, early history will be recalled by models and illustrations of such aircraft as Henson's "aerial steam carriage," John Stringfellow's successful large model monoplane and Sir Hiram Maxim's biplane (the two latter were powered by steam engines). The early years of the present century will be represented by a model of the Short No. 2 biplane—on which Col. Moore-Brabazon made the first circular flight of one mile—and by other historic aircraft, leading on to the Avro 504 and thence to the Vickers Vimy in which Alcock and Brown made the first direct Atlantic crossing.

Moving to the section covering the inter-war years, the visitor will see three full-scale aircraft : the Supermarine S.6B Schneider Trophy seaplane, the original piston-engined D.H. Comet in which Scott and Campbell-Black flew to Australia in under three days, and the first Moth. The development of world routes by Imperial Airways will be shown by a wall display and models of the aircraft used. Present-day air-transport operations, by the two Corporations, will be similarly depicted.

Contemporary types will be represented by models, which will comprise the Brabazon, Viscount, Apollo, Dove, Sealand, Prince, Comet, Hermes V, Ambassador, Bristol Freighter, Marathon, Auster, Bristol 175 and G.A.L. Universal Freighter. That these are all civil aircraft is, of course, consistent with the *motif* of the whole pavilion, which is solely concerned with transport. In this connection it seems curious that the only modern aircraft to be shown full-scale will apparently be two sailplanes (Slingsby and Newbury Eon), but presumably the space question—and possibly the strength of the roof, from which the machines are to be suspended—were the deciding factors.

Helicopter development will be shown by models of the Bristol 171 and 173 and by an actual Alvis Leonides "vertical" engine, with a full-size rotor slowly revolving above the heads of the crowd.

Propulsion seems likely to be well exemplified, starting with a number of historic units, including the Green and J.A.P. (1909) and Bristol Jupiter (1920). Coming up to more modern times, there will be a sectioned and "working" Rolls-Royce Merlin and a Bristol Centaurus, and photographs will complete the story.

In the jet-propulsion field, the experimental Whittle unit will be shown, together with a Derwent and Ghost to represent the turbojets, and a Python and Proteus as examples of turboprops. Complementary to the Whittle unit will be a model of the Gloster E. 28/39 in which it first flew. There will also be a model of a Lancaster "flying test-bed."

Air transport from the passenger's point of view will be illustrated by a large-scale model of an airliner interior, fitted and furnished in modern style. Ground organization will be explained in reference to London Airport. Communications will form part of the exhibits in the adjoining "Communications" section of the pavilion.

Components and accessories will not be overlooked, and special displays will show the part played by modern materials such as heat-resisting steels (as used in gas turbines) and light alloys; synthetically bonded structures will also be shown.

Test equipment will be illustrated by photographs, by a working stroboscope, and by an actual low-speed smoke tunnel (made by the Airscrew Co and Jicwood, Ltd.), which will be operated at various times. The R.A.E., Farnborough, will contribute a model of a rig for testing wings to destruction.

While the varied items mentioned above will no doubt interest thousands of casual visitors, it must not be forgotten that the primary purpose of the exhibition is that of a shop-window for British industry. For this reason the "Transport and Communications" pavilion, like other sections, will have a trade information bureau, at which overseas and other visitors will be able to have their business queries answered.

A TRADITION OF CRAFTSMANSHIP

MAKERS of aircraft and automobiles to-day comprise almost the entire membership of the Worshipful Company of Coachmakers and Coach Harness Makers of London. On the occasion of a Livery dinner at the Grocers' Hall, Princes Street, on Monday, March 12th, to meet the Lord Mayor and Lady Mayoress, the toast list included the names of Marshal of the Royal Air Force Sir John Slessor, Sir Frederick Handley Page, and A. Cdre. A. V. Harvey, M.P.

"The Lord Mayor, Sheriffs and Corporation of the City of London" was proposed by the Senior Warden, Maj. R. M. Woolley, and the Right Honourable the Lord Mayor (Mr. Alderman Denys Lowson) replied. A. Cdre. Harvey, proposing "The Company", said that the future of the British Commonwealth depended upon strength through air power—not strength in numbers, but in quality of aircraft and of the men who flew them. "British workmanship still leads," he said. "We have had a difficult time, but we are still the same people that we were in 1940 and we can be proud of our craftsmanship." The Master, Mr. F. S. Bennett, replied.

"The Guests" was proposed by Sir Frederick Handley Page, who said that instead of us being able to live each in his quiet house, this menace in the air had come to us. "That which should have provided better communications and more interchange between nations has been the means by which we are threatened every hour of the day with the possibilities of disaster," he added.

The Chief of the Air Staff, Marshal of the R.A.F. Sir John Slessor, mentioned in his reply the appropriateness of the Company's arms, which include "Phoebus riding on a chariot, through clouds proper, drawn by four horses." He thought that the founders of the Company would have been surprised to learn that "a chariot could have crossed the Atlantic and arrived on the other side 20 minutes before it left." British skill and craftsmanship, which had for centuries been a matter of pride, were still alive to-day. We could be proud of the fact that a British-designed light bomber, the Canberra, and a British jet engine, the Sapphire, were now to be produced under licence in America. British design genius and craftsmanship, allied to the terrific development capacity and enormous production potential of the United States would not only be a guarantee of peace but, when the clouds had rolled away—as he believed they would—would be a guarantee of prosperity for the future.

Among more than 300 guests were Admiral of the Fleet Sir John Cunningham, Lt.-Gen. Sir Leslie Hollis, Lord Kenilworth (Past Master), the Rt. Hon. Lord Nathan of Churt, the Rt. Hon. Lord Lucas of Chilworth and Sir Hew Kilner. Also present were the Masters of the Worshipful Companies of Vintners and Tallow Chandlers. The orchestra of H.M. Royal Marines (Portsmouth) was conducted by Maj. F. Vivian Dunn.

THE COLLEGE OF AERONAUTICS

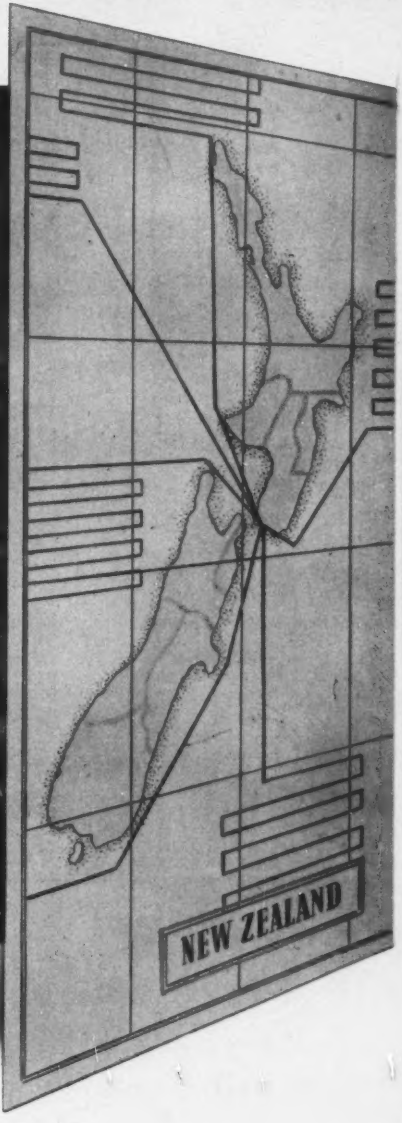
THE work of the College of Aeronautics, Cranfield, Beds, is, very fully described and admirably illustrated in a brochure recently published. The college, which began instruction in October, 1946, offers a two-year course and certain shorter special courses. In the two-year course the students devote their first year to acquisition of general aeronautical knowledge in all the departments of the college, though with some regard to subsequent specialization. In the second year they spend most of their time in the department dealing with the specialized subject they have chosen, and are encouraged to undertake design and research work on lines of their own initiative.

Departments of the college are : aerodynamics, aircraft design, propulsion, economics and production, flight, radio and electrical, and materials and metallurgy.

The scale of equipment is commensurate with the wide scope of instruction; the Department of Flight, for example, has its own aircraft fleet—a Dove, three Ansons and three Tiger Moths, and a full day-and-night traffic control service is operated.

Prospective students are selected by a board. In general, the standard required is that of a graduate in engineering, physics or mathematics, and preferably with some practical engineering experience, though neither this nor a degree is obligatory.

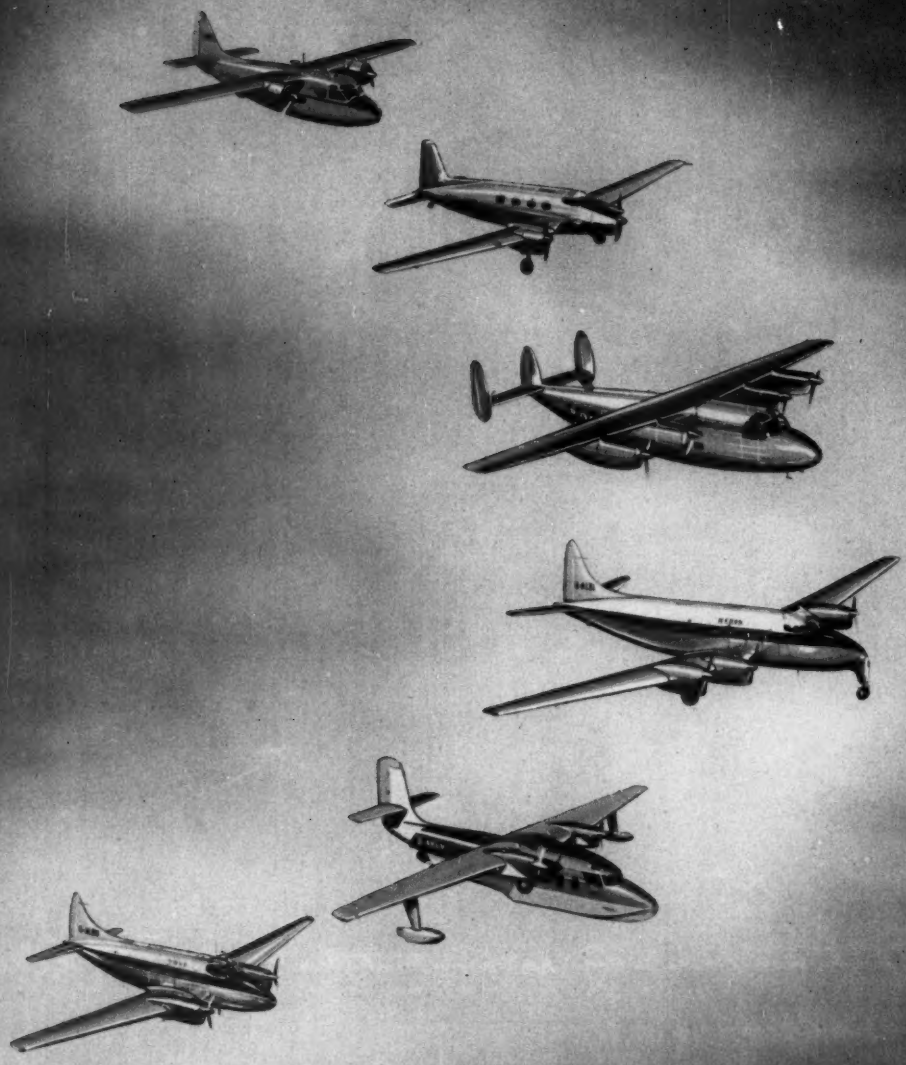
Command of the Sea



Maritime Reconnaissance Bomber is the title for an aircraft which must be capable of fulfilling a variety of roles. That is why Coastal Command Royal Air Force, is now being re-equipped with Avro Shackletons, specially designed and fully equipped for tasks as arduous as any in the history of flying. The provision of four engines, regarded as an essential, inspires confidence in the crew, whose comfort and requirements have been main considerations in the layout of its spacious interior. With the most up-to-date radio and radar, with its powerful offensive armament and low level manoeuvrability coupled with its ability to carry large and varied loads to extreme ranges, the Avro Shackleton is a formidable attacker.

Shackleton

A V ROE & CO LTD MANCHESTER *Member of the Hawker Siddeley Group*



unequalled experience in the light transport field

DE HAVILLAND PROPELLERS

DE HAVILLAND PROPELLERS LTD., HATFIELD, HERTFORDSHIRE, AND LOSTOCK, LANCASHIRE

The Sikorsky S-51, an American design built under licence by Westland Aircraft, Ltd., has already proved its mettle on B.E.A. scheduled services.

THE HELICOPTER PROSPECT

Report by M.C.A. Committee : 10/12-passenger Types in Service by 1954?

LAST week we published a brief summary of the first report of the Interdepartmental Helicopter Committee, which was appointed on August 5th, 1948, by the Minister of Civil Aviation to investigate the potential future of the commercial helicopter in this country. The committee, which was under the chairmanship of Sir George Cribbett, K.B.E., C.M.G., consisted of the following members: Mr. W. N. Cumming (B.A.C.A.), Mr. W. G. Downey (M.o.S.), Mr. W. Gordon (M.o.S.), Capt. R. N. Liptrot (M.o.S.), Mr. R. H. Locke (G.P.O.), A. Cdre. W. E. G. Mann (M.C.A.), Mr. P. G. Masefield (B.E.A.), A. Cdre. W. P. G. Pretty (M.C.A.), Mr. N. E. Rowe (B.E.A.), Mr. B. S. Shenstone (B.E.A.), Mr. R. H. Walmsley (M.C.A.), Mr. A. H. Wilson (M.C.A.), Mr. J. E. Yates (G.P.O.); secretary, Mr. I. V. Pugh (M.C.A.).

The terms of reference directed the committee to consider in relation to the helicopter's present and likely future development (*a*) the prospects of its future commercial use on internal air services in the United Kingdom and other fields of potential use, and the effect on air services (including airfield) requirements; and (*b*) the related programmes of development of the helicopter and experimental work on equipment required to achieve the necessary regularity for successful commercial operation.

A substantial body of evidence, both written and oral, was collated from the views of many individual witnesses representing the helicopter manufacturers, the M.C.A., B.E.A., the Airborne Forces Experimental Establishment and the office of the Civil Air Attaché, Washington.

Additional information was given by the B.E.A. Helicopter Experimental Unit, and by two M.C.A. working parties, established, on the one hand, to consider the characteristics and sizes of rotor stations and, on the other, to examine the scale of communications, navigational, approach and landing aids required for commercial operation. A report was also heard from a working party which was appointed by the committee to examine the scale and staff that would be needed at a hypothetical helicopter landing area at Crewe. Since it was thought that the bulk of traffic moving to and from Crewe would consist of mail, this party was placed under the chairmanship of the member representing the G.P.O.

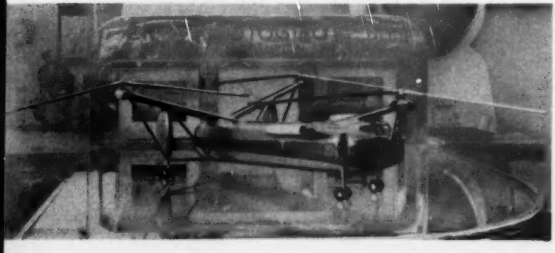
Bearing in mind the fact that any future commercial use of the helicopter must obviously have an important bearing on the operational future of fixed-wing aircraft and their associated ground organization requirements, the committee had, as one of its main objects, the task of providing some basic assessment which would help decide the directions in which overall planning should be made for the future requirements of short-haul air traffic.

The Committee's studies have thus far progressed to the stage where a number of broad conclusions can be drawn and here we give abstracts of the major points contained in the report.

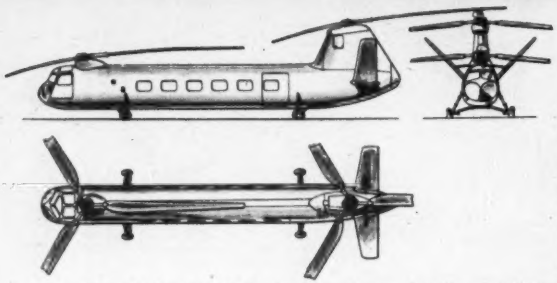
PRESENT STATE OF EQUIPMENT.—Each of the four main British helicopter manufacturers (Bristol, Cierva, Fairey and Westland) has produced and flown a single-engined machine. The Ministry of Supply has ordered three prototypes of the three-four passenger Bristol 171 Mark III, but delays have been encountered, due to difficulties with the transmission.

The Cierva Autogiro Co., has constructed two single-engined machines, the W.14 Skeeter (three of which have

A model of the Cierva W.11 T, designed to carry 30/36 passengers.



Early impression of the Fairey Rotodyne (courtesy of "Aeronautics").



This side elevation G.A. drawing shows the general configuration of the 10/12-passenger twin-engined Bristol 173, the prototype of which is expected to fly shortly.

THE HELICOPTER PROSPECT . .

been ordered by the M.o.S.) and the W.11 Air Horse, capable of carrying 24 passengers (two prototypes of the Air Horse have been flown but one, it will be recalled, was destroyed in an accident last June).

At its own expense the Fairey Aviation Co., developed the three-passenger Gyrodyne, which first flew in December, 1947; this project has since been abandoned.

Under licence from the American manufacturers, Westland Aircraft, Ltd., have produced the three-passenger Sikorsky S.51, which received a full British C. of A. in April, 1950, and is now used extensively by the R.A.F., the Navy and—for scheduled services—by B.E.A.

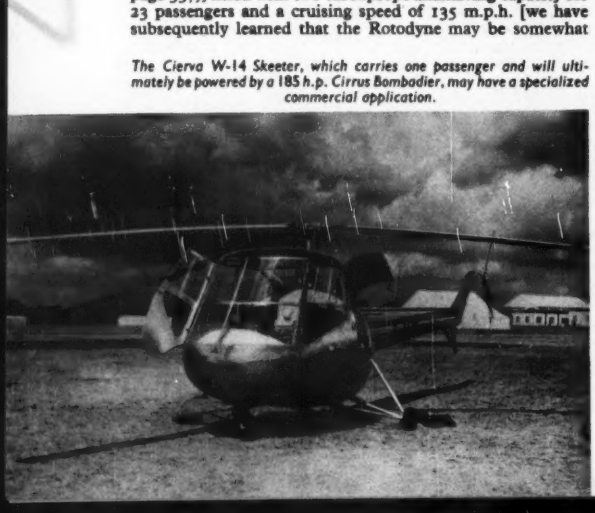
It is evident, the report continues, that the manufacture of helicopters in this country for transport use is still in an early stage. All types constructed thus far are too small and only one has been granted a full C. of A. The committee feels some concern "at the defects which have come to light in the rotor systems of all British helicopters other than the Sikorsky S-51."

Among types now under development the committee mentions the Bristol 173 twin-engined tandem-rotor helicopter with a designed cruising speed of 113 m.p.h. and a payload of 10/12 passengers. (A technical description of this type appeared in *Flight* last week.) The Cierva W.11 T., for which the M.o.S. has placed a contract for design only, is a twin-engined, three-rotor development of the Air Horse with which the manufacturers expect to achieve a payload of 30/36 passengers (or five tons of freight) and a cruising speed of 116 m.p.h. Giving evidence before the committee, the managing director of Ciervas expressed the opinion that this machine could be in production three years after work had begun on the prototype.

On the subject of what significant developments seem likely in British helicopter production, the committee reports itself as being impressed by manufacturers' unanimous accord on the need for multi-engined configurations.

To the committee, also, the head of the Fairey Rotocraft Division revealed that the Ministry of Supply had authorized his company to proceed with the preliminary development work on a new type, known as the Rotodyne (see drawing on page 337), fitted with two turboprops and having capacity for 23 passengers and a cruising speed of 135 m.p.h. [we have subsequently learned that the Rotodyne may be somewhat different from this early conception]. He believed that a prototype could be built in 1950-51 and that the machine could be in production by 1953-54. Since this design incorporates many novel features, however, the committee feels that a considerable amount of development work may prove to be necessary and that it would take longer than four or five years to go into production.

The Cierva W-14 Skeeter, which carries one passenger and will ultimately be powered by a 185 h.p. Cirrus Bombadier, may have a specialized commercial application.



The report goes on: "In the light of these developments the committee thinks it prudent to plan on the basis that helicopters of the 10/12-passenger type would be available for limited commercial use by 1954 and that thereafter they could become an increasingly important element in the pattern of Britain's transport system. It is important that practical work should be pressed forward towards the formation of a cadre of trained aircrew, the development of operating and maintenance techniques and the assessment from a user's viewpoint of the helicopter's operational and commercial characteristics."

Mentioning the work which has been carried out by the B.E.A. Helicopter Experimental Unit since July, 1947, the committee enumerates a number of important lessons which have thus far been learnt; among them are the following: (*a*) helicopter operations can be run safely in conditions of high wind, low visibility, and at night, but good navigational aids are fundamentally important for widespread operations; (*b*) the aids provided must be simple and capable of operation by the pilot alone; (*c*) the great importance of winds and performance on the scheduling of operations has also been emphasized; (*d*) the vibration factor has emerged as an important problem in connection with operation, maintenance and passenger comfort; (*e*) it has become clear that multi-engined machines with adequate single-engine performance are necessary.

OPERATIONAL CHARACTERISTICS:—The helicopter's ability to fly slowly and to-hover will simplify—and in any expected high-density traffic conditions, largely eliminate—the many complexities of traffic control which have grown up around fixed wing aircraft. Its ability to use restricted landing areas presents an opportunity for a new development in air transport—namely, services between city-centres—which may well prove a revolutionary medium of transport over short ranges.

The report details a number of basic requirements pertaining to the commercial operation of rotating-wing aircraft. Services should be planned over 50 to 300-mile stage-lengths and, to make them economic, should be operated at a frequency which ideally, should vary in inverse ratio to the block time. Operations should be between town centres and not between the perimeters of densely populated areas. At least two engines will be essential for safety in emergencies.

The committee is of the opinion that no other single factor could so effectively stifle the development of the helicopter as a repetition of the high costs inherent in the standards of passenger-service now provided on fixed-wing trunk routes. It is recommended also, that full advantage should be taken of the helicopter's high degree of controllability to avoid unnecessary complication of ground organization and approach and landing aids.

GROUND ORGANIZATION AND NAVIGATIONAL AIDS.—Of the nature of the ground organization and the navigational aids required, the committee considers that the Decca Navigator holds out promise of safe scheduled operations with a good standard of regularity in the normal weather conditions typical of this country. It would be used as a main navigational aid and would be supplemented by simple recognition-lighting systems at the landing points. It is not recommended that approach aids should be further developed at present, though research into the subject should continue.

Although, initially, traffic density is not expected to warrant the provision of a separate helicopter traffic-control organization, the committee established a working party to consider the system which would become necessary when services are fully developed. The investigators concluded that the ideal system would be based on "route control" as distinct from "area control." The precise proposal is that areas up to one mile on each side of the routes and between 500 and 2,000ft should become control areas and, at ter-

minals or junctions, areas up to three miles in radius and 2,000ft height should become controlled zones. On all sectors except those on which traffic density is high there should be no more than a skeleton organization, however, and at "low frequency" stations the A.T.C.O. should exercise general supervision over all activities.

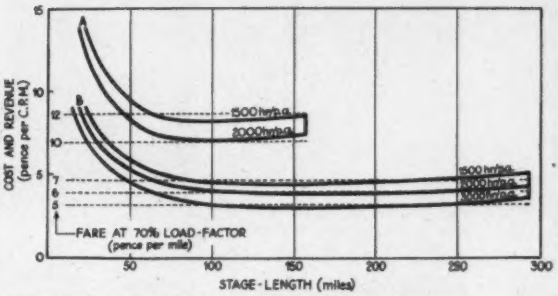
So far as communications are concerned, private telephone lines should be installed between terminals and junctions stations (and at intermediate points) for operational messages; V.H.F. R/T. should be used for ground-to-air communications at all terminal stations.

A separate working party also studied the problem of landing areas. It recommended that, at the present stage of development, it would be imprudent to prescribe a minimum area of less than 300ft square. This should be of "L" or "T" shape, giving two alighting areas 300ft by 150ft, intersecting at right angles, and an obstruction clearance at an angle of 26 deg (1:2) from the edge of the landing area. Increasing experience, however, should make it possible to reduce these margins with safety. Manufacturers, in particular, are urged to consider these recommendations as being essential requirements in the design and performance of future helicopters which, when necessary, should be able to alight vertically with power off. Attention should also be paid to the improvement of undercarriage design, so that weight may be distributed as widely as possible on landing. For parking purposes all rotor blades should be capable of being folded.

HELICOPTER ECONOMICS.—In view of the lack of experience of commercial helicopter operation, the committee has based its forecast of helicopter economics on the hypothesis that any such economical consideration should take account not only of the costs likely to fall on the operator, but also of the costs of providing and operating landing areas, traffic-control organizations and ground aids. Attention has been directed towards two main multi-engined types, the 10/12-passenger and the 20-passenger, as it is considered that anything smaller than a ten-passenger machine could not possibly operate economically on scheduled services at acceptable fares. Although the 10/12 type is thought to be too small to be economical for normal operation, the committee considers that, given short distances and high frequencies, helicopters of 20-passenger capacity would meet requirements in the foreseeable future. For the purpose of an economic study the committee has compared the early forecast performance of the Bristol 173 with that of a hypothetical design-project for a 28-passenger machine, powered by four Alvis Leonides, which would have an estimated maximum cruising speed of 142 m.p.h. Estimated gross weight is 22,000 lb. Estimated performance of the Bristol 173 gives a cruising speed of 113 m.p.h. at an a.u.w. of 10,650 lb (maximum speed is quoted as 166 m.p.h.). [It should be emphasized that the figures are those issued with the first specification about two years ago and that, in practice, the 173 can probably be expected to achieve notable improvements on this early forecast]. A comparative cost analysis is set down as follows :—

	10/12-pass.	20-pass.
	£	£
Fixed annual costs	20,460	36,420
Hourly cruising costs	11.39	18.64
Cost of take-off and landing cycle	7.87	11.71

On the basis of these costs and from reasonable assumptions for performance, scheduling and block speeds, a payload and costs chart has been prepared (Fig. 1). This shows that at a utilization of 1,500 hr per annum, cost per passenger-mile for the 10/12 and 20-passenger versions work out at 11¼d and 7d respectively. For a utilization of 2,000 hr the figures are 10d and 6d respectively per passenger-mile. From this study it is apparent that the 20-passenger helicopter, even when called upon to meet all costs, is likely to be fully economic within its own sphere of operation. The 10/12-passenger version will not be economic, though it must be regarded as an indispensable stage in the development of a fully commercial machine. It is pointed out, however, that the 10/12-passenger type is not likely to be any more uneconomic than equivalent fixed-wing aircraft over certain basically uneconomic routes such as those to the Western



Payload and cost : comparative curves—based on differing utilizations—of cost (solid lines) and revenue (dotted lines) for (A) the Bristol 173 and (B) a hypothetical 20/28-passenger type (four Alvis Leonides).

Isles; in this case the use of helicopters would reduce the cost of services by eliminating the need for airfields.

FIELD OF OPERATION.—Although the helicopter seems to postulate a field of operation where there is a reasonably high traffic-potential, the committee reaches the conclusion that, initially, services should be introduced on cross-country routes and not on those radiating from London, which present special problems of expense and difficulty in siting central landing-areas. Initial development of services should take place either between medium-sized provincial cities where surface transport facilities are not of the best, or over water or difficult terrain, or between international airports and seaports and their provincial hinterlands. It is recognized, however, that there may be a primary familiarization stage where routes may be determined by purely operational considerations. It is believed that the use of helicopters for linking city centres with "fixed-wing" airports will be expensive, and more suitable to taxi services.

Some examples of comparative rail and helicopter journey-times are quoted from Glasgow to various other centres : to Manchester by rail 6.2 hr as against 1.8 hr by helicopter; to Newcastle 4.1 against 0.12; to Leeds 5.2 against 1.8; to Hull 7.2 against 2.1; to Nottingham 8.0 against 2.2.

The report mentions that B.E.A. are now carefully studying the selection of routes and terminals so that the mistake should not be made of planning fast, high-frequency, helicopter services between localities in which the relative inconvenience of other transport facilities merely reflect a low traffic-potential. An attempt is being made to evaluate the real degree of social and business intercourse between given towns. Freight and mail is expected to follow broadly the same routes as passenger services, although special mail routes may develop in the case of major mail-collecting centres like Crewe.

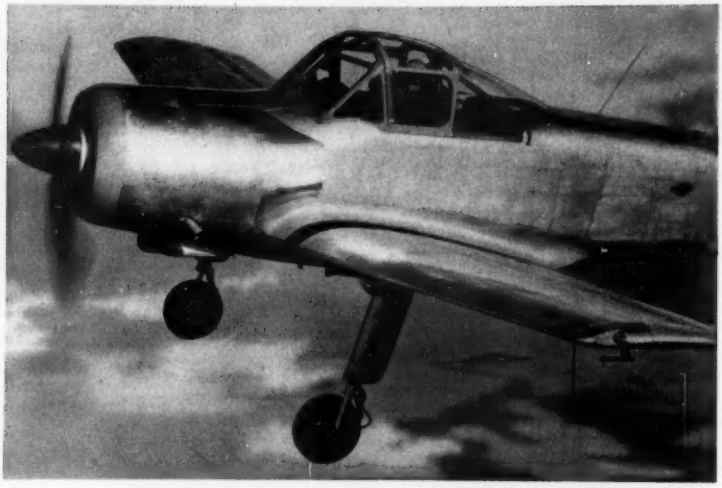
Of the actual numbers of helicopters for which a requirement is foreseen, it is thought that although 50 might suffice initially, this number might well grow progressively to 100 machines within a comparatively short time.

The committee holds the view that, so far as capital resources and other national preoccupations permit, the development of helicopters suitable for commercial operation should be intensified and arrangements made to build up user-experience in the United Kingdom. It is believed that a twin-engined 10/12-passenger type can be in commercial use by 1954 and that a 20-passenger version, with increased cruising speed should be aimed at by 1958.

In its own sphere, the report continues, the helicopter can be used commercially at rates comparable with those of fixed-wing aircraft of similar capacity. The cost of ground organizations required should be considerably lower than those for corresponding fixed-wing types and, when the traffic-potential is fully developed, should become financially self-supporting at landing fees below current fixed-wing rates.

A typical cost for the acquisition and preparation of a ground-sited rotor-station is quoted at £30,000 which, together with the cost of communications, lighting and emergency equipment, would amount to approximately £37,000. The 11 personnel who would be required to man it would account for £9,000 of the £16,000 which is estimated as being the total annual cost of such a rotor station.

For comparison an overall annual cost of £24,500 is envisaged for roof-top landing areas.



In close company with the photographic aircraft, the P-56 shows its neatly cowled 500-h.p. Alvis Leonides radial engine and roomy cockpit with side-by-side seating. The P-56 has been ordered for the R.A.F.

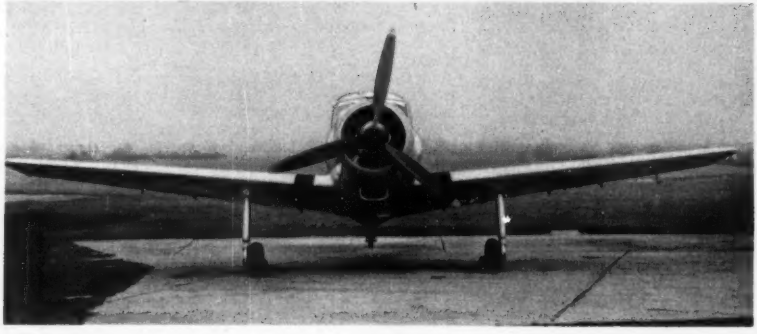
(Below) Detail view of the sturdy fixed undercarriage with oleo-pneumatic leg incorporating (at top) a taxying lamp.

PERCIVAL CLOSE-UPS

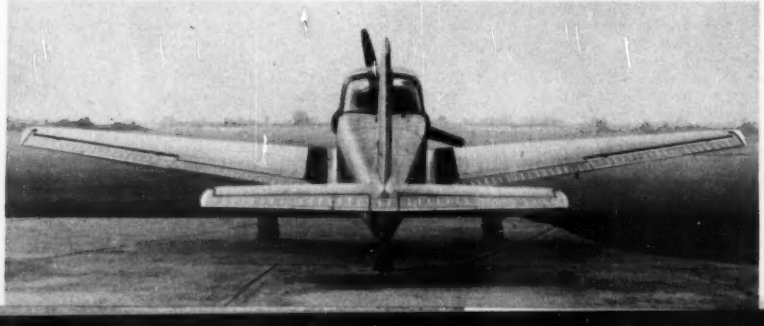
New Views from Luton: P-56 Leonides-powered Basic Trainer

("Flight" photographs)

(Above) In charge of P-56 test-flying is R. G. Wheldon (left), Percival's chief pilot; D. M. Bay, a war-time chief pilot, is now the company's assistant sales manager.



The frontal appearance (left) of the P-56 is trim and tidy; the width of undercarriage-track can be readily appreciated.

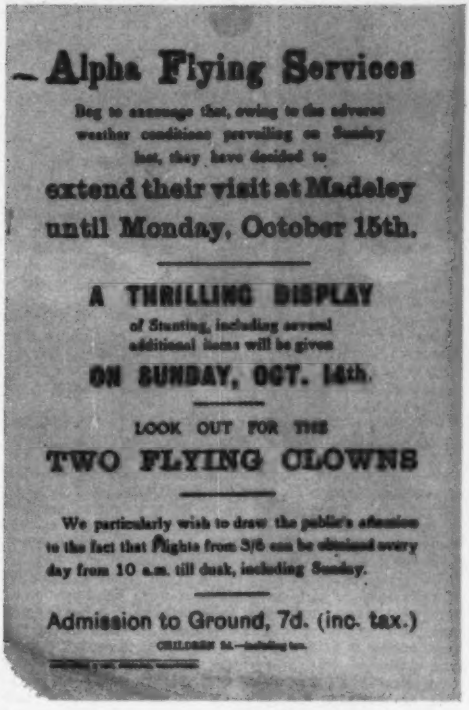


As seen in this stern view, control-surfaces are metal-covered and the fuselage is of simple rectangular section. The P-56 is an all-metal aircraft.

WEATHER PERMITTING...

Some Nostalgic Memories of the Rotary-engined Avro 504, Backbone of the Barnstorming Business

By STUART CAMPBELL BRANDER


Alpha Flying Services
Beg to announce that, owing to the adverse weather conditions prevailing on Sunday last, they have decided to
extend their visit at Madeley until Monday, October 15th.
A THRILLING DISPLAY
of Stunting, including several additional items will be given
ON SUNDAY, OCT. 14th.
LOOK OUT FOR THE
TWO FLYING CLOWNS
We particularly wish to draw the public's attention to the fact that Flights from 3/6 can be obtained every day from 10 a.m. till dusk, including Sunday.
Admission to Ground, 7d. (inc. tax.)

IT is probably true to say that most people now in early middle age received their first taste of flying in the rear cockpits of the faithful Avro 504s used in the 'twenties and early 'thirties by the majority of the small concerns doing what the Americans call "barnstorming" flying. In this article Mr. Stuart Brander—now with the publicity department of the Gloster Aircraft Co., Ltd.—recalls those happy-go-lucky days as seen by a ground engineer with one of those hard-working troupes.

MORE so, perhaps, than any other veteran type at last year's R.A.F. Display, the Avro 504 must have brought acute attacks of nostalgia to many spectators. Hundreds of Service pilots received their *ab initio* training on this endearing type, and there are many others who were once engaged in the joy-riding of circus business (or, as some would have it, "racket"): that fraternity of pilots who, throughout the summer months, persuaded their 504s out of incredibly small fields and, after completing the required circuit, gracefully "swish-tailed" in to a brakeless landing. There are also their ground engineers, who attended to the whims of the 504's rotary engine, Clerget or Le Rhône, and carried out maintenance and repair work under conditions peculiar to this type of flying.

To make as small a circuit as possible without bringing adverse comments from passengers on the subject of value for money was all part of the game, as was the strenuous wing-tip "braking" performed by many of the hard-worked G.E.s—who also, on occasions, acted as "barkers" to attract custom, and even as wing-walking stunt artists.

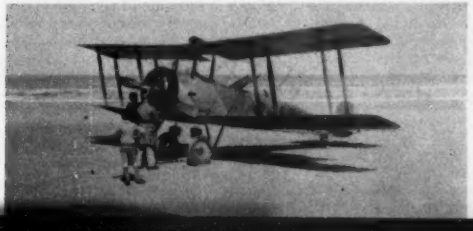
For my own part, memories of the 504 are still particularly vivid, and it is perhaps symptomatic of the modern trend of development that barely ten years after I had applied the last serrated-edge patch to that slender fuselage, with its "artist's palette" rudder, and assisted the last passenger down the ladder that was always used, I was instructing members of the R.A.F. in the maintenance and repair of their first jet fighter.

On the rare occasions to-day when a racing car or motor cycle leaves a trace of that aroma of burnt castor oil, there is echoed for me the metallic clatter and "plop" of a Clerget's valve gear during "sucking-in," or its hesitant "blipping" when making an approach.

My last engagement as a G.E. on a rotary-engined 504 was in the early summer of 1935 at Camber Sands, near Rye. Later that year I joined Sir Alan Cobham's circus, whose fleet of 504N Avros were, of course, radial-engined.

The 504 used at Camber Sands was something of a mongrel, as an authentic "N" airframe, owing to the scarcity of Lynx engines, had been modified to accommodate a Clerget rotary. This unusual combination gave us the benefit of the many "more modern" features of the "N"-type airframe, e.g., variable-incidence tailplane, Frise ailerons, R.A.F. flying wires and the absence of the "K" type of shock-cord undercarriage with its attendant "toothpick." How often one tripped over the latter item and its snare-like bracing wires!

The start of a day's work: On the sands at Rhyl, in North Wales.



Yet it was always handy as a step to stand on while "sucking in," or for use as a lever to bring the c.g. forward when lifting a 504K by its tail preparatory to moving it in or out of a hangar.

This rotary-engined "N," however, had but a short life, primarily due to its non-standard fuel system. This consisted of a single "N"-type gravity tank under the top mainplane, and it was not ideal for the unorthodox carburation of a rotary. When the fuel-level was low and steep turns were undertaken, starvation resulted. Nevertheless, the aircraft had received its C. of A. and the original pilot seemed quite happy. After a few weeks, however, a new pilot was temporarily engaged. Though already a claimant to fame by having force-landed a Moth in the Thames at Westminster, the new arrival had had no experience of rotaries. After brief instruction in the art of joint manipulation of throttle and fine-adjustment control and, of course, of the correct use of the "blip" switch, he successfully accomplished observed landings and take-offs, loaded and unloaded.

Business was at once resumed and when, as was usual in order to encourage trade, it was decided to carry out a "prop" flight (or, in modern parlance, a "beat-up"), the idea was entered upon with enthusiasm. A low-level flight along the beach, and what was intended to be a steep climbing turn to run the wheels along the roof of the "local," brought a protesting splutter from the Clerget, for the tank had not been topped-up since flying had commenced in the morning. Mishandling of throttle and fine adjustment resulted in a choked engine and the necessity for a dead-stick landing. A creditable effort to pull off a downwind landing to avoid the many people on the beach failed—with disastrous results

WEATHER PERMITTING . . .

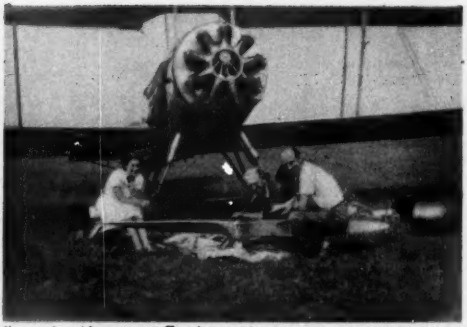
to my last rotary-engined 504. Hurried and drastic measures to remove the aircraft beyond reach of the fast-incoming tide resulted in an almost complete write-off.

Previous seasons with 504s had been more profitable. The year before, at Rhyl, we operated directly from the sands, even continuing at high tide when but a narrow strip of foreshore remained. Our "runway" was marked out with red flags which, not surprisingly, were at times insufficient deterrents to prevent children, during a lull in flying, from digging large sand-castles in the middle of the area; and the ensuing ruthless destruction of these hazards often led to tearful protests from their owners or, worse still, to irate admonishments from parents. Absent-minded bathers on their way to the sea, too, would cross over just at the moment of take-off, whilst the ever-present beach dogs were a constant source of worry.

On Bank Holidays business was particularly brisk, and flying would be almost continuous from early morning till dusk. At times, long queues (yes, there were queues even in those days) would form, and the enthusiasm and guilelessness of intending passengers were amazing. On occasions, prospective joy-riders even offered to assist in some necessary repair or maintenance work in order to speed up the resumption of flying. Small boys were at all times available to assist in the washing-down or other similar jobs. But, for the G.E., operation from the beach meant double the amount of work involved in normal field-operation. Sand penetrated everywhere and, with the assistance of the oil-slinging properties of rotary engines, adhered to everything. In consequence, a perfect grinding paste was formed at pulleys and fairleads; this necessitated constant replacement of control-cable "short ends." Proficiency at splicing was therefore an essential qualification. Under conditions now reminiscent of the North African campaign, and in a canvas Bessoneau hangar on the sand dunes above the beach, we actually carried out a C. of A. on one of the two Avros we were using. Of these two 504s, one was again somewhat of a hybrid, having been modified to seat *three* passengers in addition to the pilot. Apart from alterations to the top longerons, this conversion also necessitated the use of Bristol-Fighter-type outside flying controls.

Except for the renewal of undercarriage shock-cord, the Avro airframes required very little maintenance. Also, in view of its often strenuous work, the average rotary, either Clerget or Le Rhône, was surprisingly trouble-free when employed on this type of flying. Since the Le Rhône was not equipped with dual ignition, it was only with the Clerget that one could finally obtain a C. of A. There were times, of course, when one wished that M. Clerget had never been born and wondered why such a power unit had ever been produced. Valves had a habit of dropping into cylinders, due to the shearing of the stem at the cotter-pin hole, and another frequent trouble was an absence of "sparks," usually traced

Refuelling a three-seater Avro with the aid of two-gallon cans.



". . . joy-riders even offered to assist in some necessary repair or maintenance work in order to speed up the resumption of flying."

to an oil-soaked distributor ring. (Remedying this necessitated wrestling with the most devilishly devised fireproof steel plates surrounding the magnetos.) Cylinders, also, were known to shear off at the base-retaining spigot where it was clamped between the two halves of the crankcase.

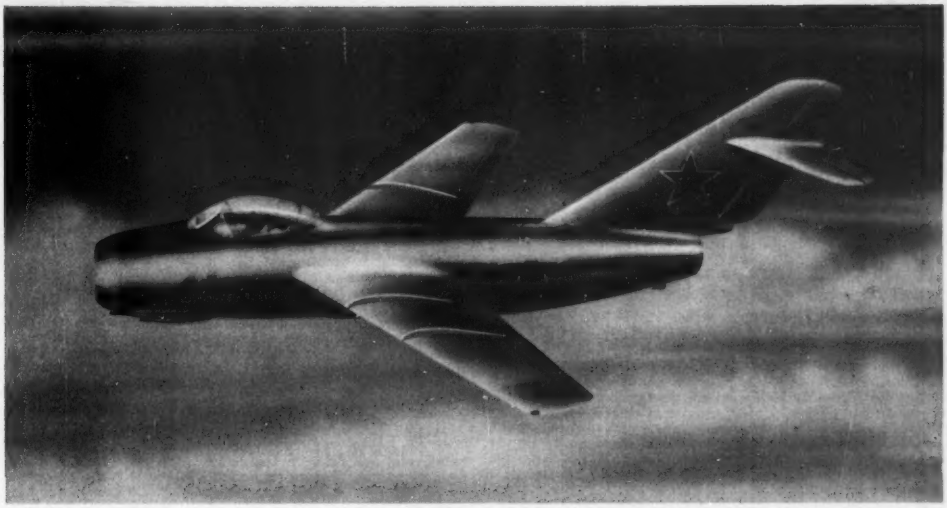
The regulation top overhaul period for a Clerget was 90 hours. A "top," however, virtually meant a "complete," as the crankcase had to be split to remove the non-detachable-head cylinders.

Most joy-riding outfits had one or two or even more engines ready for immediate substitution. In the 'thirties, new Clergets could still be purchased for a few pounds from Rollason's, Coley's or other sources, whilst all spares were still plentiful, so that new (*sic*) engines could be fairly easily built up. The famous bronze "obturator" top piston-rings, however, began to get somewhat scarce.

Decarbonization and general cleansing of an engine—which, with the exception of the pistons, was entirely of steel—usually consisted in placing the more or less complete unit in a bath of boiling caustic soda. This also helped removal of the valve cages for valve grinding. The inlet valves of the Clerget were flat seating, whilst the much-larger-diameter exhaust valves were of the more familiar countersunk type. Valve springs were of little importance as, once the engine was in motion, centrifugal force automatically closed the valves. Tappet clearances at contact of rocker head and valve stem were in themselves quite irrelevant and would often, with the valve closed, be in the region of a quarter of an inch. This was the result of excessive shortening of the push-rod to obtain the correct timing: the very finely made and clever sun-and-planet cam gear gave the basic valve timing, but final adjustments were made *via* the push-rods.

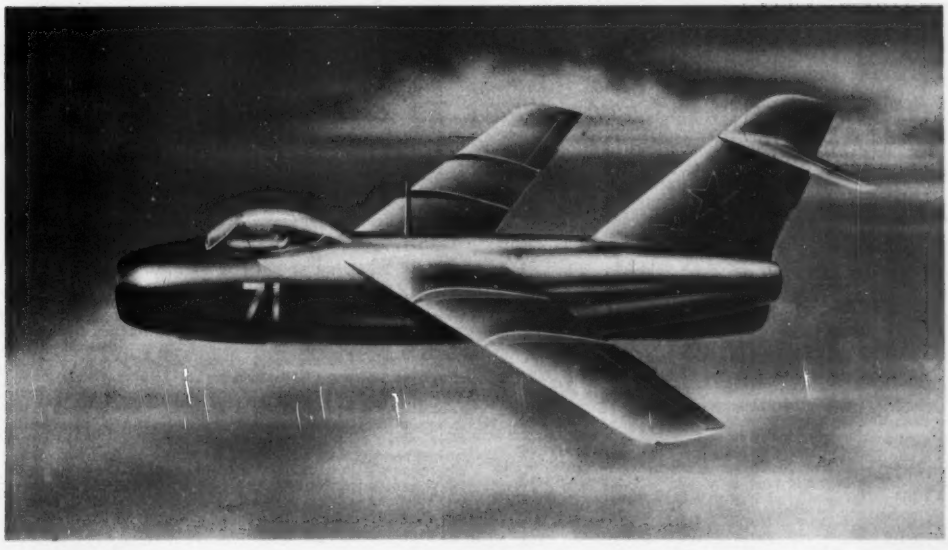
This was *not* the official procedure, but I suppose that "now it can be told." The same remark applies to engine oil. With the very-much-non-return system of the rotary engine, consumption could be as much as three gallons an hour and, since the lubricant had to be pure castor or vegetable oil, it could be quite an expensive item. Resort was frequently made, therefore, to non-branded castor oil purchased from the local chemist, and usually of "veterinary grade." If our consciences ever worried us over the use of non-D.T.D. "cattle castor," we argued that "anyway, it wasn't in the engine for long."

In this era, apart from the straight joy-riding outfits and the one or two big air circuses, there were also a number of small circuses with the usual assortment of 504s. Distributed handbills or posters promised "15 minutes of death-defying aerobatics," or "a thrilling display," or that "the human fly will walk the wings (weather permitting)." In my own case, I saw to it that the weather did not permit too frequently. Aerial sharpshooting, bombing the motor-cyclist or motor-boat, flying clowns, passengers grave and passengers gay, ladders slung under the fuselage, the petrol squirt so necessary for priming . . . all have faded away with the blue haze left by the last of the rotary-engined 504s.



RUSSIA'S DARK HORSES

THOUGH Mig-15 fighters have frequently been engaged—and occasionally destroyed—over Korea, a detailed assessment is still not possible. W/C. "Johnny" Johnson, lately home from the scene of action, is reported to have said that the Russian machine has a better climb than the F-86 Sabre, is as fast in the dive and more manœuvrable, but is slower on the level. The latest information concerning the external appearance of the Mig has been used in preparing the drawing above. The lower illustration depicts a second Soviet fighter (possibly designated La-17), and affords a most interesting comparison. Both types are operational in large quantities, and both are much superior in speed to any R.A.F. fighter. (*Flight* copyright drawings.)



HYDRAULIC SERVICEABILITY

A lecture before the R.Ae.S. by R. H. Bound and H. G. Conway

INTRODUCING their lecture entitled *Progress Towards Hydraulic Serviceability* to a Royal Aeronautical Society audience at the Institution of Civil Engineers on Thursday, March 15th, Mr. R. H. Bound, M.I.Mech.E., F.R.Ae.S., and Mr. H. G. Conway, M.A., M.I.Mech.E., F.R.Ae.S., stated that because they were both closely associated* with the design of the product whose serviceability they were to discuss an excellent opportunity was offered for a critical survey of the field uninfluenced by commercial considerations. They also pointed out in introduction that 99 per cent of the world's aircraft are fitted with hydraulic equipment; this was an answer to anyone who suggested overcoming the difficulties experienced with hydraulic systems by their complete elimination.

The hydraulic installation of an aircraft was now such an important and integral item of equipment that any steps which might be taken towards improved performance in serviceability would contribute notably to the operational success of transport and military aircraft. The degree of complexity required in modern aircraft hydraulic systems was such as to make impossible a completely foolproof system. But consideration of factors which kept trouble within very small bounds was of vital importance.

To give a brief historical background to the subject, the authors mentioned that the first hydraulic systems were fitted to aircraft in the period 1934-35 and were confined to undercarriage retraction and flap operation. Automatic devices were not used and the pump was unloaded manually. Such refinements as thermal relief valves, hydraulic locks, flow synchronizers, and so on, were unknown.

By 1939, the extent of hydraulic systems had increased by the addition of bomb-door operation and occasionally other services.

The trend with the typical bomber of to-day was towards a great increase in the number of services operated hydraulically and to a much higher degree of emergency protection, involving system duplication. In Table I below, the hydraulic services on a Lancaster bomber are compared with those of a typical bomber of the present generation.

TABLE I: HYDRAULICALLY OPERATED SERVICES

Lancaster	Modern Bomber
Main undercarriage.	Main undercarriage.
Wing flaps.	Main undercarriage doors.
Bomb doors.	Nosewheel undercarriage.
Hot air intake.	Wing flaps.
Fuel jettison.	Bomb doors.
	Dive brakes.
	Dive recovery brakes.
	Camera door.
	Wheel brakes.
	Nosewheel steering.
	(Power flying controls to all services).

Numbers of Components

Hydraulic pumps	2	Hydraulic pumps	5*
Hydraulic jacks	17	Hydraulic jacks	25*
Selector valves	7	Selector valves	14*
Total of hydraulic components (other than pipe connections)	51	Total of hydraulic components (other than pipe connections)	135*
Approx. total length of piping	230ft	Approx. total length of piping	1,450ft

*Excluding flying control systems.

It was clear that the number of services in the modern bomber had introduced a considerable degree of additional complication. The fixed tailwheel had been replaced by the retractable and steerable nosewheel. The mechanical interconnection of undercarriage doors to the landing gear was now often impossible, and separate hydraulic jacks with sequence control were required to operate the doors.

Pneumatic brakes were often replaced with hydraulically operated disc brakes, the latter in some cases being fitted with automatic skid-detection devices which involved additional piping and controls. Dive and dive-recovery flaps were a new requirement. Many additional services must be operated under conditions of emergency (as when a pipe was broken, or damaged by gunfire), and this had meant that the bomb-door circuit must be operated in both directions by emergency means. Power flying controls, operated either from the main or an auxiliary system, would be fitted on many aircraft, thus adding to the complication.

The lecturers next made a brief reference to emergency systems. It was often better to provide an adequate degree of safety or reliability in the original system than to introduce a secondary system to deal with any possible failure which might occur.

Under the heading "Types of Unserviceability," the authors drew upon the experience of the firms with which they were associated, and on information obtained during discussions with maintenance commands, airline operators and service managers. The two usual troubles were (*a*) those which were experienced with a new type of aircraft; (*b*) those which occurred even on well-established machines.

The first type of trouble arose because sometimes there was insufficient time for the hydraulic engineer fully to develop his equipment. Hydraulic systems on each prototype aircraft differed in such matters as pipe runs, pipe bends, reservoir position, and so on. There were factors which necessitated the testing of every new system to ensure satisfactory operation. Notwithstanding that all the components had been fully tested, the system could prove at fault through variations in the installation.

Another difficulty was the inability of the hydraulics engineer to test the complete system under altitude conditions and this, in certain circumstances, could give rise to troubles.

It was general practice nowadays to build extensive rigs on which the systems were tested, but sometimes the hydraulic engineer had insufficient time to complete tests on the rig before the aircraft flew. No rig, however perfect, could exactly simulate flight conditions.

Concerning the second type of trouble, statistical appreciation of the problem was needed to enable the difficulties to be put into proper perspective. The objection of many engineers to the use of hydraulic flexible pipes was cited as an example. Modern aircraft might have between 30 and 50 such pipes, and it would be difficult to believe that a few failures were serious, as the overall percentage in terms of the number of pipes being used would be extremely small. Principal causes of the trouble were known to include the following: (*a*) fracturing of hydraulic pipes, usually at the pipe joint flare; (*b*) leaking pipe-connections; (*c*) failure of seals; (*d*) failure of a component due to swarf or dirt; (*e*) failure due to faulty assembly; (*f*) failure of hydraulic pump for any of a number of possible causes, the chief of which were dirt and suction strangulation; (*g*) secondary difficulties such as leakage due to corrosion; (*h*) failures of flexible pipes.

Lines of improvement next considered in detail were as follows: (1) basic improvement in design; (2) improvement in testing technique to enable troubles to be eliminated at an early date; (3) improved installations to facilitate assembly and removal.

It might be assumed here that the complexity of the system had been reduced to a minimum. The first factor to be considered was that of pressure; although it had not been stated specifically, it was a fact that pressures had risen and would continue to rise as aircraft hydraulic power requirements increased. Higher operating pressures had enabled the weight of modern aircraft systems to be kept within reasonable bounds. It was of interest that the hydraulic power available on the Lancaster and Halifax bombers was about 12 h.p. compared with 30 h.p. on a modern bomber.

There was no direct evidence that hydraulic serviceability or reliability was affected by pressure. Hydraulic seals appeared to be rather less reliable at high pressures than at low pressures, but evidence was not conclusive and other factors were often more critical. It was thought that increased pressures must be accepted. This must be qualified by saying that there was not much advantage to be gained in raising pressures of a system which was in continuous operation, as for example on powered flying controls, operating at 3,000 p.s.i. There was, however, everything to be gained on large aircraft in raising the pressures on the remainder of the system to 4,000 p.s.i. or even higher.

A factor of considerable importance to the design of the system was the choice of pump—whether of variable volume or constant type with cut-out—and resulting from this, whether the system should be maintained under pressure or whether it should be "off loaded." Some believed in the variable volume pump as a means of effecting an overall simplification of the system, and others believed that the performance of variable volume pumps left much to be desired and preferred the rather more complex system using an accumulator and cut-out as being more reliable, particularly when more than one pump was used. The authors believed that both types of pump had correct spheres of applications. With both types of pump, however, it was normal practice to maintain the system under pressure and automatically to bring the pump into operation as soon as the system was selected and oil delivery was required.

The earliest hydraulic systems used a manual by-pass which was

*Mr. Bound is technical director of Dowty Equipment, Ltd., and Mr. Conway occupies a similar position with British Messier, Ltd.

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HYDRAULIC SERVICEABILITY . . .

normally opened when the aircraft was in flight and the undercarriage and so on was retracted, and when hydraulic selection was required, the by-pass cock had first to be closed. A variation of this system was the so-called "open centre" circuit where the by-pass valve was contained within the main selector, the lever of which returned to a neutral position after completion of a selected operation. Due to the possibility of failure to close the by-pass valve and of the selected operation not taking place, this system fell into disrepute. Automatic systems were introduced about 1938.

There had now been a partial return to the earlier system on certain civil aircraft by the introduction of an off-loading valve with automatic cut-out so that the pump and system were not damaged if the pilot forgot to open the valve after take-off. On transport aircraft it was preferable to off-load the system to zero pressure, rather than to leave the pump cutting in and out to maintain the system at full pressure. Properly supported pipes should not fail if they were not under pressure. The off-loading system, therefore, appeared of considerable benefit.

Whether such an off-loading system could be considered for a military aircraft was an interesting point. The authors believed that it might be considered for bomber and transport types of aircraft but that it would not be practicable for fitment to a fighter or other short-range aircraft. It was obviously not applicable to the part of the hydraulic system which might operate powered flying controls.

Another important point in design was to provide for easy maintenance at low temperatures. A simple operation might take five minutes at normal temperature, but 15 or 20 minutes at —30 deg C. Intricate operations such as fitting locking wire might be almost impossible to perform with cold, gloved hands.

Regarding hydraulic pumps, it was the author's opinion that type test requirements were severe. While not suggesting that the present 100-hr type-test schedule should be altered, pump designers should aim at a minimum life of 1,000 hr for a good hydraulic pump. A type of pump which could be considered of variable volume was one which achieved this feature by the incorporation as a unit of a constant volume pump and a cut-out. This type of pump had advantages over the variable-volume kind, but when two or four pumps were used in parallel, the normal type with a single cut-out might be preferred.

The cylindrical piston type of hydraulic accumulator had long been used in Great Britain and was now coming into service in the U.S.A., the "bag" or diaphragm type having been superseded on account of difficulties with the rubber diaphragm at low temperatures. The mounting of accumulators in a vertical position with the air chamber on top was recommended. The reliability of the piston glands could be improved if a small amount of oil was added to the top of the accumulator (air chamber), this acting as a lubricant to the air seal. The practice of chromium plating the cylinder bores was one which was believed to be desirable.

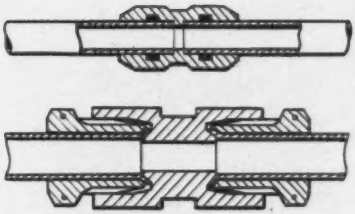
The practice of fitting hydraulic jacks with internal locks was now well established, and the locking devices (of the collet type) were most reliable. The fitting of satisfactory indicators to these locks was difficult, particularly as the seals involved were of small dimensions. An additional seal would prevent loss of oil from the system. (See illustration, right). Hydraulic jacks could be improved by (*a*) the addition of built-in filtration, and (*b*) by hard-chromium-plating the cylinders and piston rods.

Micro-switches should be arranged so that wiring required little or no movement when a jack was removed. A robust adjustment for switch position was essential.

Selectors and other types of valve normally relied on ball or poppet valves, or the cylindrical-slide type of element. The earlier practice of using unguided balls had now been largely abandoned, as this led to indentation of the ball, permitting leakage. Modern practice was to use properly guided poppet valves, or a hardened steel ball trapped in a guiding member.

Plastic valve elements had been used successfully. The design and manufacture of cylindrical slide-valves for use at the pressures common to-day was not easy. The clearances involved (0.0001 to 0.0002in) created problems of metal stabilization and distortion under pressure. Partial locking and increase of friction occurred with time, and were aggravated by "micronic" particles of swarf or dirt. To ensure adequate valve-life, endurance testing up to 100,000 cycles was now regarded as essential.

Material now in use for piping was steel or proprietary products such as Tungum; these could be considered reliable. The suitability of the material to stand flaring was a critical factor affecting reliability. Improved flaring technique to avoid sharp edges greatly increased reliability.



Improved pipe joints: a suggested internal-cone type, and above it, a flareless type with rubber sealing rings.

The weight of piping on modern aircraft represented as much as 30 per cent of the total hydraulic system weight, and research into the possibility of using pipes of reduced wall-thickness in lighter materials was important. High-tensile steel tubing, bench-formed and welded at "T" or cross connections, might be used.

The authors went on to discuss various details such as the spacing of pipe-supporting clips; pipe connections and flexible hose. The flared pipe connections now used in Britain and the United States were, they considered, satisfactory, but in France compression-olive-type connections were still used. The British A.G.S. connection was heavy, costly and somewhat difficult to flare, and the adoption in this country of the new unified thread system created an opportunity for a new type of connection (two suggestions are illustrated on this page).

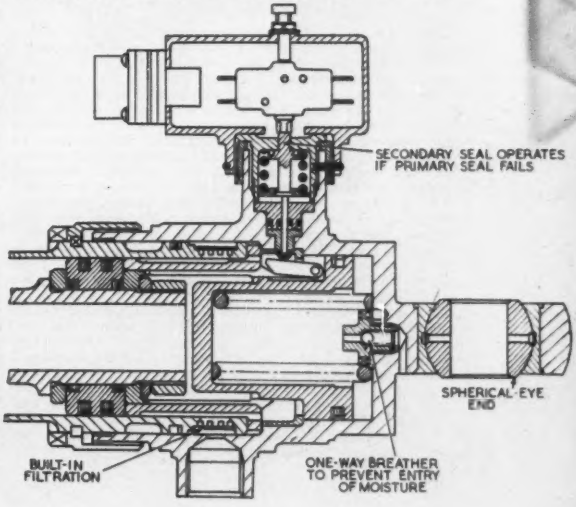
It would be of interest to British engineers, said the authors, to know if the American use of tapered pipe threads to replace copper or equivalent washers on adaptors was to be recommended.

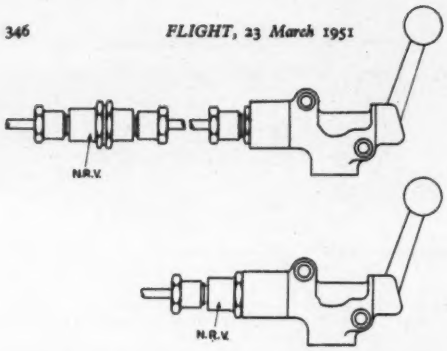
On the subject of filtration, good modern practice was to provide (*a*) gauze protecting-filters in the reservoir or in the pump suction-line connection; (*b*) a very fine filter in the inlet connection to the automatic cut-out or the connection between the pump and the selectors; (*c*) gauze protective filters in the pipelines; (*d*) built-in filtration in components such as jacks. Components having small orifices, such as restriction valves, should be fitted with built-in filters or alternatively be provided with automatic cleaning devices of some simple type (see illustration, top left).

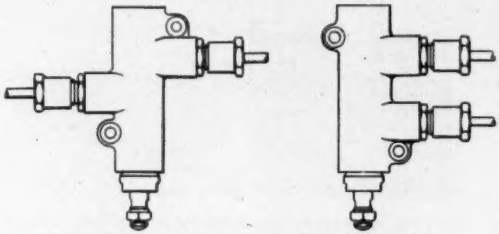
The authors did not foresee much development in hydraulic fluids except in the introduction of some non-inflammable fluid or one with improved low-temperature performance.

Under the heading "Development Technique" the authors stated that modern practice in the development of an individual hydraulic component was to make many tests of the unit performance, culminating in an official series of tests in order to obtain the necessary official flight approval and so-called design clearance. Tests on a typical hydraulic selector, for example, would include the following: (*a*) pressure testing; (*b*) leakage testing; (*c*) endurance testing—operating, say, 100,000 times

Details of hydraulic-jack construction, with special features annotated.


SECONDARY SEAL OPERATES IF PRIMARY SEAL FAILS
SPHERICAL EYE END
BUILT-IN FILTRATION
ONE-WAY BREATHER TO PREVENT ENTRY OF MOISTURE





(Left) An example of grouping; a non-return valve is screwed into the body of a selector. (Above) Examples of bad and good practice in the location of pipe connections on units. The method in the right-hand illustration is, of course, preferable.

HYDRAULIC SERVICEABILITY

without failure; (*d*) low-temperature testing to prove operation at, say, 65 deg C.

The general use of large hydraulic test rigs had enabled systems to be tested under conditions as close as possible to those in the aircraft. It was usual to carry out a large number of operations (say, 10,000) of an agreed cycle—undercarriage, flaps, bomb doors, and so on. The process of development could be summarized as consisting of the successive elimination of faults.

The installation of hydraulic components on an aircraft was a difficult problem, particularly on the modern thin-winged aircraft where accessibility was poor.

Next in importance to reliability was accessibility, so that a component which became unserviceable could be rectified quickly. On some aircraft insufficient attention had been paid to this point. Examples illustrating the type of difficulty encountered were : (*a*) hydraulic selector mounted so that the engine must be removed before the hydraulic unit could be serviced; (*b*) hydraulic pump so inaccessible that removal took six hours; (*c*) valve mounted behind a control panel, necessitating the removal of engine and control cables before the valve was accessible.

Other cases occurred where the location of a component led to a secondary difficulty. In one known case a hydraulic pipe was frequently flattened by nipping between a structural member and the rear end of a gun when the latter was slid into position. Other difficulties had occurred with hydraulic components so located that, when they were removed, oil dripped on oxygen equipment or electrical gear.

A difficulty arose with the installation of small components such as non-return valves. It was usual to engrave an arrow on these units indicating the direction of flow, but often they were installed the wrong way round. It was not practicable to make the connections of different size, and it was suggested that the aircraft constructor should paint an arrow on the airframe adjacent to the component to indicate the correct direction of mounting. Similar labelling of pipes passing through bulkheads would help in tracing pipes during overhaul.

The grouping of components inside a common body might sometimes hinder maintenance. It introduced difficulty in tracing a fault and involved diamantling a complete assembly when only one item needed rectifying. For example, it might be preferable for the pump and cut-out to be separate units. Pumps submerged in reservoirs, and pumps with integral relief valves, and selectors with internal thermal-relief valves, were examples of such multiple units. However, a saving of pipe connections was a factor to be considered, and the local grouping of components in a common body could sometimes be beneficial. (An example is illustrated above of a non-return valve screwed into the body of a selector.)

Various sources of unserviceability and leakage, particularly those caused by insufficient care during maintenance, were next discussed, and the authors then went on to deal with power-operated controls. On this important subject they stated that in order to guard against failure of any one part of the system, it was usual to duplicate the installation completely, including the hydraulic-jack units, pipes and pumps. The net result was a complex system. In the event of one system failing, the other must be able to operate with the minimum delay and, in fact, it was usual to have both systems operating simultaneously. Power controls were a comparatively new development, and it was not considered possible to discuss serviceability at this early stage of development.

The degree of reliability which had already been achieved with aircraft fitted with all powered flying controls was surprising and said much for the detailed thoroughness with which the systems had been prepared. The hydraulic engineer was not able to put forward ingenious proposals which would make sure that the system was foolproof; careful design and adequate development were essential.

Failures of hydraulic-powered flying control systems were almost invariably due to detailed mechanical faults and the increased mechanical complexity of the hydraulic pump, and motor systems would appear to aggravate the position.

The use of electric control of hydraulic components was a necessary feature dictated by weight-saving considerations, or the need to eliminate pipework entering pressure cabins. The need for means for operating a selector in the event of an electrical failure involved the introduction of mechanical override on selectors, and this might be objectionable.

Proposals had been made from time to time for use of self-contained hydraulic units equivalent to electric actuators. These consisted of electric motors driving hydraulic pumps mounted with selectors on the hydraulic jacks themselves. At first sight these units appeared to be attractive, but further investigation indicated that they had an unnecessary degree of complexity.

Aircraft designers were often tempted to make use of hydraulic control on new requirements which might arise. These new applications might often be found to be perfectly satisfactory as, for example, a hydraulic locking system for control surfaces when servo tabs were used. On the other hand, although such devices as flow dividers and flap synchronizers were known and were in production, a conscientious hydraulic engineer would not allow his ingenuity or skill to get the better of his good judgment, and would recommend such devices only for application where failure of the hydraulic unit did not cause serious difficulties.

As a result of their experience, the authors did not advise the use of manual-hydraulic remote controls. These could perform extremely well in the laboratory, but it had not been found possible to evolve seals which on the one hand allowed the operating friction of the control to be sufficiently low to interfere with the feel of the unit, and on the other to prevent slight leakage as they were operated.

A principal reason for the introduction of the hydraulic brake was, said the authors, that the smallest size of operating pistons had had to be used in order that the hydraulic part of the brake did not mask or interfere with the direct air-cooling of the brake discs. This had meant that brake operating pressures of 1,500 lb/sq in or higher had been used in preference to the 150 lb/sq in which was current on the earlier bag-type pneumatic brake. An important point which must be watched in any brake design was that there was provision for preventing oil leaking past one of the seals onto the hot brake-disc surface, as a fire might result.

It seemed likely that automatic brake-governor devices would be introduced, but it was too early to say whether these were likely to introduce complications from the serviceability point of view. It should be possible to arrange that, if they went wrong, the normal operation of the brake was not adversely affected.

Of the future, the authors said that aircraft hydraulic equipment had become stabilized in its broad conception. Undoubtedly hydraulic solutions would be found for means for varying wing or tailplane incidence. Hydraulic devices would be developed for producing artificial feel, for g-restriction and, possibly, for gust alleviation.

The future would bring development in ultra-high-pressure hydraulic systems, although the authors were not able at this stage to predict how far the pressure might ultimately exceed the present 4,000 lb/sq in development. Improvements must take place in pipe material, because the weight of piping on a modern hydraulic system was excessive. It seemed probable that the work being done in Great Britain and in the U.S.A. in the development of non-inflammable hydraulic fluid would eventually produce a satisfactory result.

The authors concluded that the tendency towards increased complexity of the hydraulic system was the principal difficulty. Aircraft designers could do much to facilitate the overall performance of hydraulic systems by improved installations. The greatest problem which the hydraulic engineer was contesting was ingress of foreign matter into hydraulic systems.

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THE NAVY ESTIMATES

Naval Aviation Matters Discussed in the Commons: Statement and Debate

OPENING last week's Debate on the Navy Estimates, 1951-52, the Parliamentary and Financial Secretary to the Admiralty, Mr. James Callaghan, said the net cost of the Navy this year was £278,000,000. This compared with a sum of £193,000,000 for which the House was asked on the previous occasion. There would be a further estimate later in order to support the programme laid before the House by the Prime Minister on January 29th.

After discussing expenditure, Mr. Callaghan said of the naval rearmament programme that by late next year as much as 30 per cent of the labour force in the shipbuilding and ship-repairing industry ought to be engaged upon the work of the Navy. He then turned to the work of the Service during the year, referring in particular to affairs in the Far East. When the Korean trouble started, he said, the Far Eastern Fleet was a thousand miles from its base and doing a summer cruise. Within three days it was on station, and within six days it was engaged in operations and had sunk half a dozen North Korean E-boats. Within eight days sorties were being flown from H.M.S. *Triumph*, the light fleet carrier attached to the Fleet.

A really outstanding feature of the naval side of the operations had been the work of H.M.S. *Theseus*. The ship's company had worked in such a way that no aircraft had ever been unserviceable for longer than two hours, and they had had the remarkable and unprecedented record of 1,300 deck-landings without a failure and without an accident. When an accident had at last come, it was a minor one in very rough weather. Mr. Callaghan also referred to the forced landing in a damaged aircraft made by Lt. Leonard, R.N., of H.M.S. *Theseus*, and to his rescue from behind enemy lines by a United States helicopter. He felt sure the House would wish to express their appreciation of this fine example of co-operation between two nations.

Technical needs of the Navy was another subject to be discussed. In answer to a question put by Mr. Callaghan to the Controller of the Navy, he had been told that whereas a television set had about 20 electronic valves in it, the latest piece of naval equipment for anti-aircraft purposes had 2,000 valves, 25,000 other components, and needed 20,000 drawings in order to produce it.

Regarding new ships, Mr. Callaghan said that the *Eagle*, the latest and biggest aircraft carrier, was at the moment undergoing her sea trials. Work was being pushed ahead also with the *Ark Royal* and with the four *Hermes*-class light fleet carriers. These four carriers would be able to operate the latest aircraft existing or being developed. When the new three years' programme was completed, the Navy would possess altogether 232 new ships.

Turning specifically to the question of Naval Aviation, Mr. Callaghan said that at our war-time peak we had 11 fleet and light fleet carriers and to-day we had 12, an increase of one. As he had stated earlier, there would be some additions to this number under the rearmament programme—the *Eagle*, the *Ark Royal* and four *Hermes* carriers—so that we should then have a total of 18 carriers, plus three in the Commonwealth navies, making 21 in all. That compared with the 11 which we had during the peak of the war. He thought it was a substantial addition to Naval Aviation, and it was a development which he certainly regarded as being in the right direction. We were up against great problems with the heavier and faster aircraft which we were now getting. They threw a greater strain on the arrester gear on the deck and also created a problem about the height of the hangars. This would involve a process of modernization and conversion to some of our existing carriers.

He thought that during the 'thirties and early 'forties the Navy suffered from the fact that so many of its aircraft were adaptations of machines from the Royal Air Force. What were good aircraft for the R.A.F. did not necessarily meet the requirements of the Navy. He should like to tell the House that we had coming along now a series of tailor-made planes for the Navy—aircraft which could search and strike and fight. The Sea Hawk jet fighter would be coming into use during the financial year about which he was now speaking and it had a performance which he believed would rival that of any landplane. In addition, there was the Wyvern, which was coming into use this year—a turbo-prop strike aircraft. Very great importance attached also to the G.R. 17, an anti-submarine type which had been specially designed for carriers. It was a three-seater and, he believed, would be found capable of doing really important work in its field which had not been done before.

Meantime, we had the Attacker which would be coming into operation this year. That was really an interim machine—what we really wanted to rely upon, said Mr. Callaghan, was the Sea Hawk—and also the Fairey Firefly. One other type he had forgotten to mention was the Venom, which was a night fighter for operation from carriers, and that would be coming into operation at the end of 1952. There were also newer types at present on the drawing-board.

Helicopters were engaging the Navy's attention in quite a practical way. Hon. Members might have seen some photographs of the experiments in flying helicopters off the deck of the *Fort Duquesne*, a Fleet auxiliary vessel, and it was hoped that helicopters, together with the G.R. 17s, would be able to make great use of the sonobuoy, to which reference had been made in one or two debates in the past. Sonobuoys, with which experience was steadily being gained, were dropped either from an ordinary aircraft or from a helicopter; they could be dropped at different places, and used for listening to submarines which could not be seen. They relayed what they heard to the helicopter or to the ordinary aircraft, and in that way the sonobuoy was a very useful and very formidable means of defence for any convoy coming behind. It would enable us to improve and develop our methods of dealing with submarines.

There was at the moment a shortage of naval pilots. This was, he thought, due to the lack, in the past, of the aircraft that we should have liked to have had, and it was now hoped that, as a result of the new aircraft that were coming along, pilots would be forthcoming in much larger numbers.

On this question of pilots, Mr. Callaghan emphasized that a boy coming into the Navy now as a pilot came in as an executive officer in the Royal Navy. It was a career and the rates of pay and conditions were good. The rate of pay for a married lieutenant on full flying duties, and aged 25, was about £985 a year. In addition, a ration allowance was made for anyone living away from an air station. National Service boys would be welcomed, too and the Navy was prepared to give a number of commissions to National Service boys who were ready to fly.

THE DEBATE

In answer to a question from SURGEON LT. CDR. BENNETT regarding orders for Fireflies of a late mark, Mr. Callaghan said that the new mark was a three-seater that would do the anti-submarine job exceedingly well until the G.R. 17s were produced in large numbers. It was an interim machine, but had quite a long life in front of it.

MR. J. P. L. THOMAS said that it was obvious that, in future operations, Naval Aviation would have to play an increasingly prominent role not only in defence of the fleet and of convoys against air attack, but in offence against submarines. For these reasons, it was all the more disturbing to read about the serious shortage of officers for flying duties. He was glad that the aircraft that they flew now could compete on equal terms with anything that the R.A.F. could produce. Mr. Thomas went on to discuss matters affecting pilot recruitment—married quarters, the prospects of a flying job in civilian life, the formation of an aircrew reserve for the Navy.

Later, he said that the larger our Continental contribution became, the more powerfully it was equipped in mechanization and with tanks, the heavier our bombers became, and the faster our fighters flew, so their dependence on the Royal Navy for the safe conduct of fuel and supplies increased.

As was the case during the debate on the Air Force Estimates, members expressed fears on the question of co-operation (and recognition of friendly ships and aircraft) between the Navy and the Royal Air Force. MR. J. P. W. MALLALIEU thought that it was pretty clear, whether we liked it or not, that the safety of the realm in the future would chiefly depend on the R.A.F., which seemed to be taking the senior place. He was quite certain that this, which was an inescapable fact, would be deeply resented by some people in the Navy who looked upon the R.A.F. as an organization for cultivating moustaches. It was very important that in any future war the R.A.F. should be able to distinguish between a ship that was friendly and one that was not.

SURGEON LT. CDR. BENNETT contributed several ideas and well-considered arguments on the subject of the contribution which aircraft could make. He said that the future of the Navy was bound up more than merely partially with the use of air power to combat submarines. He quoted past records of submarine sinkings.

He referred at considerable length to an article, "Tasks of Naval Aviation," written by the Director of Air Warfare of the Admiralty. He felt that almost every word of the article seemed entirely related to the ideas of 1938. Whatever the aircraft might be, it was, thought Cdr. Bennett, the semi-official estimate of the Admiralty that only within 400 miles of *terra firma* could it be expected to carry out the lion's share, if not the main task of patrol against submarines. He could hardly believe that this was so in these days. The Catalina, he believed, had a

(*Concluded at foot of page 349*)

DUNNE to DELTA

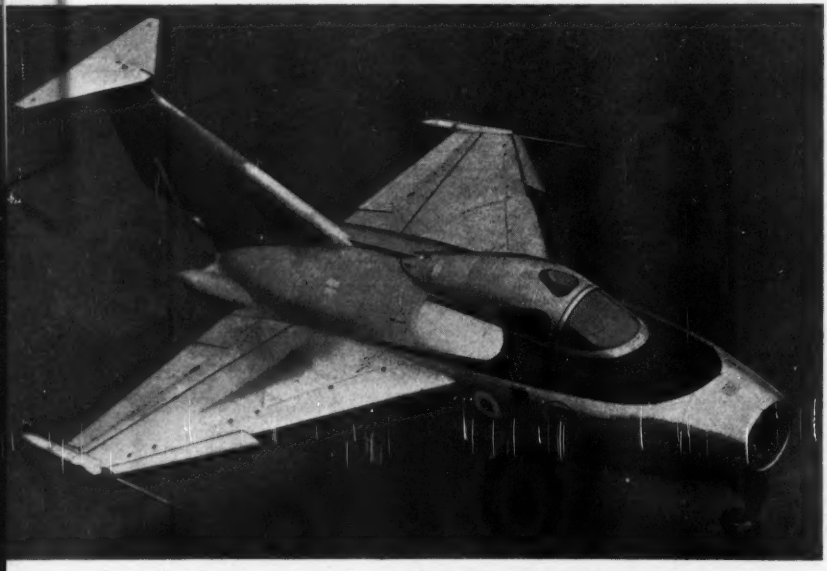
First Flight of Fairey F.D.1 Recalls Sir Richard Fairey's Work on 1911 Tailless Aircraft

BRIEF reference was made in our last week's issue to the maiden flight—at Boscombe Down, on March 12th—of the Fairey F.D.1 delta-wing research aircraft, the first photograph of which we reproduced. The pilot was G/C. R. Gordon Slade and the flight was of 17 minutes' duration. Certain new facts, and an historical background of unusual interest, can now be given.

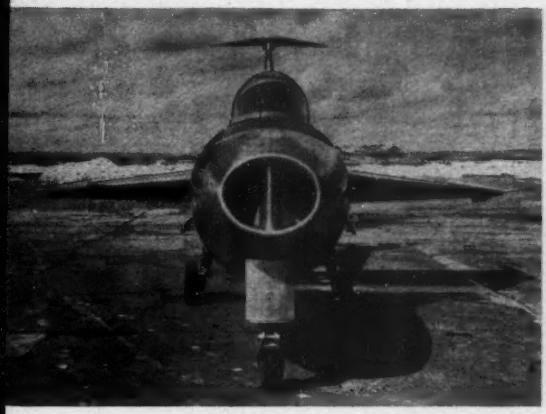
The F.D.1 is the outcome of a lengthy period of concentrated effort. Several years ago a research programme, based on the delta configuration, was advocated by the Fairey company. This received the support of the Ministry of Supply, and a number of pilotless radio-controlled scale models were flown to acquire basic data.

Of exceptionally small dimensions (it measures only 19ft 6½in in span and 26ft 3in in length) the F.D.1 was designed "for important research work with revolutionary possibilities in the design and operation of fighter aircraft." The small tailplane and fixed wing-tip slots are precautionary measures for early flight-testing. Air brakes and wing-tip parachutes are fitted "to deal with flight emergencies," and a central drogue-type parachute is installed in the rear end of the fuselage to relieve the wheel brakes during the landing run. Flying controls are in the form of "elevons" and a rudder.

The Fairey company points out that the delta configuration not only gives the low drag characteristics necessary for very-high-speed flight, but it affords a stiff structure with—what is



The two views of the F.D.1 on this page between them illustrate salient design features: the delta plan form of the wing and of the temporary tailplane; the fuselage lines and vertical tail surfaces; and (the reader may amuse himself by conjecturing their purpose) the cluster of fairings at the rear of the fuselage. The heavily reinforced cockpit enclosure betokens very high speeds.



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This front view shows the intake to the bifurcated duct for the Rolls-Royce Derwent turbojet; the undercarriage; and the temporary slots.

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It will be seen in the above side view that the delta layout has necessitated painting the Service markings on the front part of the fuselage.

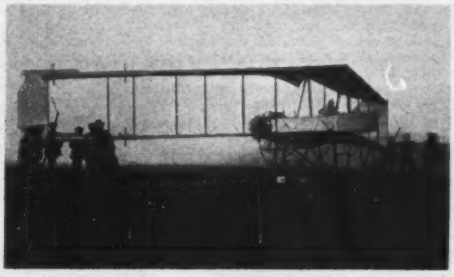
most important—stowage space for fuel, armament, etc., within the profile.

Models used in the research programme embodied every form of swept-wing pattern, including forward-swept as well as compound ("W" and "M") configurations.

Although the F.D.1 is the first Fairey aircraft of delta form, it is of interest to recall that Sir Richard Fairey, chairman and managing director of the Fairey Aviation Co., Ltd., was one of a team of workers associated with Mr. J. W. Dunne when, in 1911, he was successfully flying his swept-wing tailless biplane at Eastchurch. Dunne's efforts produced an aircraft which was inherently stable; so high, indeed, was the degree of stability that the pilot was able to leave his controls in flight and step out of the cockpit on to the lower wing. On one occasion the Gnome engine failed in mid-Channel, but the pilot trimmed the aircraft by locking the controls, left the cockpit and went aft to investigate. The source of the trouble was an ignition lead which had fallen off. This being replaced, the engine was re-started and the flight continued.

Below is the Dunne tailless biplane, built at Eastchurch. With this remarkable machine Sir Richard Fairey was concerned during 1911.

"Flight" Photograph



THE NAVY ESTIMATES (Continued from page 347)

cruising range of 27 hours. A Shackleton could be expected to oversee an area of sea reaching considerably more than 400 miles from land.

The cost of flying aircraft about the sea might be high in terms of petrol, but the great item was that if carriers were used for patrolling deep sea, they would be fixed round the middle of the Atlantic, which was a place where they ought not to be. Furthermore, they would need to be escorted by numerous smaller ships which could be used much more profitably guarding convoys. The value of these carriers was simply terrific, and 2,000 men's lives would be at stake in them. He believed that shore-based aircraft could do the job more economically.

Another point from the article he had referred to earlier was that it was assumed that an advantage of using carriers all over the ocean was that they were mobile. Cdr. Bennett submitted that 25 knots was not mobile when seen from the air. Aircraft were on a different plane of mobility altogether and were far more appropriate when dealing with other aircraft, and infinitely superior in mobility to the submarine.

Referring to the argument that an aircraft carrier could put up fighter cover, Cdr. Bennett asked if it would not be possible that some very long-range aircraft could be primarily offensively armed as anti-aircraft long-range fighters with the task, not of interception, but merely of frustrating the attempts of enemy aircraft to attack convoys. In conclusion, Cdr. Bennett said he was not sure that the Government had fully appreciated the potentialities of long-range shore-based aircraft. There should be some consideration given to the use of four-motor aircraft by the Royal Navy. In brief, he would say "put the money into aircraft; they are much better value."

Later, Cdr. Bennett referred to Coastal Command as the most neglected of a whole series of neglected branches of the R.A.F., and suggested that it was now time to have another welcome change of name of the Fleet Air Arm so as to include the functions previously exercised by Coastal Command, and to do a deal with the Air Ministry to take over their unwanted child.

MR. SHACKLETON, in the course of his contribution to the debate, said that he believed that the general dividing line in the question of the control of aircraft was that between aircraft which took-off from land, which should be under the Air Force, and aircraft which took-off from ships, which should be under the Navy. The reason the latter should be under the Navy was because the Navy had many peculiar habits of their own, and it was highly desirable that those who went to sea should understand those habits and be able to conform to them.

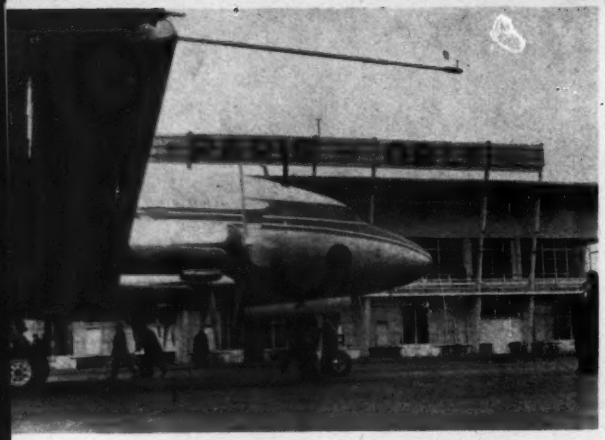
Later he stated that in war-time the bulk of aircrew would not be those who were in the Navy or the Air Force and were trained in peace-time. There would always be a great expansion and in the end we should depend on men trained for the job in war. The idea that they must be sailors to fly with the fleet at sea was impracticable in war-time.

The Admiralty ought seriously to consider developing the cheapest possible ship from which aircraft could take-off to join in the anti-submarine patrols, said Mr. Shackleton. Consideration should even be given to building a special type of anti-submarine escort carrier.

Mr. Shackleton believed that with the new type U-boats the aircraft was, to a large extent, already neutralized. It could play an important role, and even if it could no longer hunt to exhaustion, it could keep the U-boats down; but he did not believe that the aircraft was the effective reply to submarines, even with the sonobuoys, to which the Parliamentary Secretary referred. They must have supermen in the Navy and in the Air Force to make effective use of the sonobuoys, because the operational technique of making use of the sonobuoys in hunting was something which called for a very high degree of training. He believed it was necessary to preserve the sort of balance we had in the last war between the Navy and Air Force in naval operations.

The Navy should have operational control over Coastal Command, said Mr. Shackleton. It was exercised much better from the time the Navy had formal operational control because they no longer had the inhibitions which were caused by fear that the Air Force would not do what they asked them to do, and we had far less interference after the formal change of operational control than before. But, as part of this control, the Navy should have the admirals who understood aircraft. The U.S. Navy had the advantage—and this was one argument for the Navy's having land-based aircraft—of having admirals with a wide experience in aviation. CDR. PURSEY commented: "Tell that to the Marines."

CIVIL AVIATION



PARIS VISITOR: On March 12th the Armstrong Whitworth Apollo made its first journey outside the United Kingdom—a proving flight to Paris. The trip from Baginton airfield, Coventry, to Orly, took 1 hr. 26 min. while the return flight was made in 1 hr. 18 min. The Apollo, which was awarded a C. of A. on January 1st, is expected to make further proving flights to Zurich, Geneva and Brussels during the next few months.

A FEATURE printed recently in a London newspaper, and having the appearance of an officially inspired announcement, caused some surprise by implying that the Brabazon might be used by B.E.A. on the London-Paris passenger service. There is at present no more than a germ of truth in this premature suggestion. The position as we understand it must be prefaced by a series of "ifs." If suitable financial arrangements could be made between B.E.A. and the Ministry of Supply; if a full C. of A. were applied for and issued for the Brabazon Mk 1 (or presumably the Mk 2, or both); if the research and other duties of the aircraft permitted it; if arrangements could also be made for crewing and for servicing the Brabazon, and providing it with the requisite aids and equipment; and if fittings, including high-density furnishing, could be installed, then B.E.A. would be interested in the possibility of hiring one or both of these machines for use at peak times of the year on high-density routes such as London to Paris.

Peak Saturday travel in the summer holiday months has a potential of several thousand passengers a day to the most popular destinations, and the use of very high capacity aircraft on just those peak days has obvious attractions. B.E.A. state that so far no detailed discussions have taken place. As there is no possibility of any Brabazon being available with a C. of A. before the summer of 1952 at the earliest, there seems to be plenty of time to consider the matter before opening serious negotiations.

These considerations apart, we like the idea of using these impressive giants for services between European capitals, and have no doubt that passengers would thoroughly enjoy the experience of flying in them.

THE B.E.A. CHAIRMANSHIP

THE Minister of Civil Aviation has announced that the term of appointment of Lord Douglas of Kirtleside as chairman of B.E.A. has been extended until March 13th, 1954. Lord Douglas' original appointment, which was dated March 14th, 1949, was for three years and his term has thus been extended to cover a five-year period. The chairman of B.O.A.C. holds his office for a similar term.

U.A.L.'s PROFITABLE YEAR

AMERICA'S second largest internal operators, United Air Lines, have again enjoyed a satisfactory year. The company's net earnings for 1950 totalled almost $6,500,000, which compares with the net profit in 1949 of $2,250,000,000. For the first time in any year United realized more than $100,000,000 in revenue. While operating expenses also reached a new maximum of $91,000,000 unit costs were reduced.

Improved efficiency and a higher volume of traffic were reflected in the reduced operating cost per revenue ton-mile—of 45.6 cents, as compared with 50.3 in 1949, and 54.6 cents in 1948. As a result of increased earnings, United's board of directors declared a 75 per cent dividend on the Corporation's common stock—the first since 1946.

The principal traffic results for the year were: revenue passenger-miles flown, 1,494,876,664, revenue passengers carried, 2,492,497. The revenue passenger load-factor achieved was 69 per cent, a gain of 1.9 per cent on the figure for the previous year.

Although a major factor contributing to this improvement of United's traffic was considered to be the increased industrial activity caused by the Korean situation, it is nevertheless recognized that results were in some measure due to the public's increasing acceptance of air transport.

Because of competition, United entered the air-coach market on the Pacific coast early last year, using 66-passenger DC-6s. Steady expansion of this type of traffic has been maintained, but the company is by no means certain that this type of travel will prove entirely beneficial to operating results. It has yet to be decided whether the question of diverting from standard services to maintain the required high load-factors under intense competition at lower rates is fully justified. It will be recalled that last September the C.A.B., recognizing the extent of the problem, ordered that all "coach" rates should maintain a level of at least 4½ cents per passenger-mile and that they should continue to be restricted to off-peak hours.

On the subject of air freight, United feels that although the actual growth of traffic in this category during the year was satisfactory, most of the rates currently being charged are still unrealistically low.

I.A.T.A.'s DEPUTY DIRECTOR

I.A.T.A.'s newly appointed Deputy Director-General, M. Stephane P. Thouvenot, took over his new duties at the Association's Montreal headquarters last week. He will assist Sir William Hildred, the present Director-General.

M. Thouvenot

Formerly the Director of Air Navigation and Transportation in the French Ministry of Transport, M. Thouvenot was appointed to his new office on January 1st. He has spent the last two months in Europe familiarizing himself with the work of the I.A.T.A. traffic conferences, with which he will be particularly concerned.

M. Thouvenot, who holds the rank of General in the Armée de l'Air, is best known for his work in creating a maintenance and repair base for the French Air Force in North Africa during the last war. After the liberation he was appointed Director of the Department of Aeronautical Production, later in his career becoming Director of Air Transport.

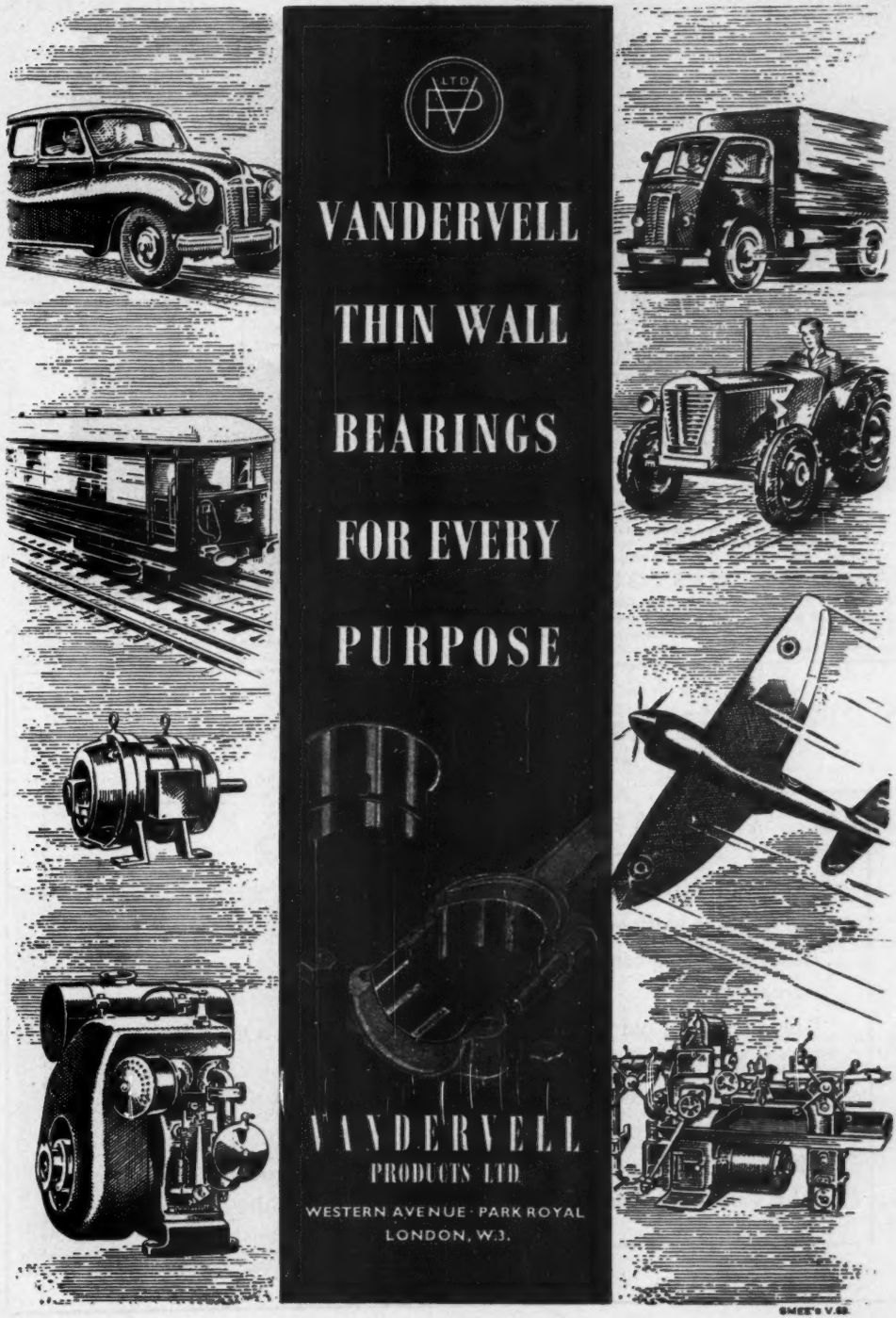
In various capacities M. Thouvenot has taken part in many international negotiations and in recent years has assisted in the drafting of many bilateral agreements between France and other nations. He is a Chevalier of the Legion of Honour and holds the Medaille de l'Aéronautique. He is also an experienced pilot.

EDINBURGH-LONDON SERVICE

THE chairman of the Scottish Advisory Council on Civil Aviation, Sir Patrick Dollan, has now been officially informed of the reinstatement of B.E.A.'s Edinburgh-London service, around which controversy has recently arisen.

With effect from April 16th these flights will consist of one morning and one evening service on the southbound route and a mid-day and an evening flight in the northbound direction. It will be recalled that the morning and evening services were cancelled last November and at the end of February the remaining direct services were completely suspended for a week for "technical reasons".

B.E.A. has said that, if there is a demand for additional services during the Edinburgh Festival every endeavour will be made to meet the situation. Meanwhile it is hoped that Edinburgh traffic will build up enough to warrant the provision of three scheduled services during the spring, summer and autumn seasons.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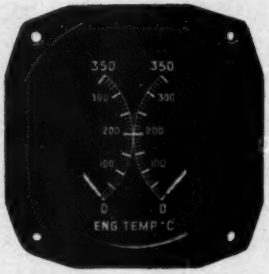

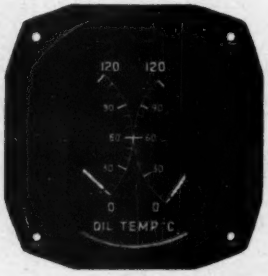

Illustrations show:

Above : Model 5128. Dual Engine Temperature Indicator, comprising two Millivoltmeters of 100° scale housed in large size S.A.E. case. For use in conjunction with copper/constantan, iron/constantan or chrome/alumel thermocouples.

Below : Model 5127. Dual Ratiometer Indicator, comprising two 100° Ratiometer movements housed in large-size S.A.E. case. For use in conjunction with thermometer bulbs, electrical oil pressure transmitters, electrical position indicators or any combination of two of these to indicate a variety of temperatures, pressures or position.

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"For that matter, I don't know what 'gate valves' are either"..... "Oh"
"Or 'anti-surge valves' "..... "I say, old man"
"Eh?"..... "You know your trouble, don't you?"
"What's that, old boy?"..... "You take this advertising too seriously"

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CIVIL AVIATION . . .

JANUARY AIRFIELD ACTIVITY

AIR-TRANSPORT movements at British civil airfields in January totalled 9,938, slightly less than in the corresponding month of the previous year. The total of all aircraft movements, at 23,282, represented a decrease of 7.8 per cent as compared with last year's figure.

Though the number of passenger movements (103,384) showed little change compared with last January, freight rose by over 16 per cent to 2,030 tons; London Airport and Northolt together handled 64,758 passengers (or 62.6 per cent) of all passenger movements. The figures for the two individual airports are now beginning to reflect the transfer of services from Northolt to London.

The next busiest British airport for passenger traffic during January proved to be Prestwick, which handled 6,195 passengers. Detailed figures for the larger airfields are shown in the table below.

Airfield	Aircraft Movements			Passengers handled (terminal and transit)	Freight (tons)
	Air Transport	Other Flights	Total		
Aberdeen (Dyce)	274	632	906	1,127	15.4
Belfast (Nutts Corner) ...	399	23	422	5,066	37.4
Birmingham (Elmdon)	172	327	499	1,105	16.4
Blackbushe	124	950	1,074	1,453	105.6
Blackpool (Squires Gate) ...	48	557	605	129	—
Bovingdon	36	951	987	696	16.9
Bristol (Whitchurch)	25	877	902	49	5.1
Cardiff	57	213	270	36	—
Croydon	227	523	750	114	84.6
Edinburgh (Turnhouse) ...	112	888	1,000	473	.7
Gatwick	11	105	116	30	6.7
Glasgow (Renfrew)	691	558	1,249	6,035	29.7
Hurn	32	1,104	1,136	404	2.1
Isle of Man (Ronaldsway) ...	275	26	301	2,340	18.0
Inverness (Dalcross)	150	17	167	519	2.9
Kirkwall	247	23	270	1,256	7.9
Leeds (Yeadon)	1	149	150	2	—
Liverpool (Speke)	326	648	974	2,802	67.7
London	2,049	795	2,844	34,972	911.9
Lympne	7	221	228	6	2.3
Manchester (Ringway)	523	541	1,064	3,315	166.7
Northolt	2,567	653	3,220	29,786	474.9
Nottingham (Tollerton) ...	—	90	90	—	—
Prestwick	429	324	753	6,195	27.6
Shoreham	—	266	266	—	—
Southampton (Eastleigh) ...	195	320	515	1,681	1.8
Southampton Water	11	—	11	259	.3
Southend (Rochford)	10	1,279	1,289	44	2.7
Weston-super-Mare	17	80	97	12	—
Wick	255	37	292	495	6.8
Other Airfields	668	167	835	2,983	17.5
All reporting 1951	9,938	13,344	23,282	103,384	2,029.6
Airfields 1950	9,961	15,286	25,247	103,292	1,743.0
Channel Islands: Jersey ...	959	n/a	n/a	4,945	38.2
Guernsey ...	646	n/a	n/a	2,512	39.8
Alderney ...	188	n/a	n/a	754	11.0

FIRE-FREEZER: This adapted U.S. Army fire-engine, in service at London Airport, carries a formidable battery by which CO_2 and foam can be sprayed on and into a crash. The tank has capacity for some 6,000 lb. of liquid CO_2 and 300 gall. of foam solution.

PACIFIC TRAIL-BLAZER

ON March 13th the Catalina flying-boat *Frigate Bird the Second*—which, as mentioned in *Flight* of March 2nd, is carrying out a survey of a possible Pacific route for regular services between Australia and South America—took off at dawn from Grafton, New South Wales, and landed at Noumea, New Caledonia, the following morning. Before leaving for Suva, Fiji, on the second leg of the flight, the crew of four were entertained by the Australian Consul and later the pilot, Capt. P. G. Taylor, broadcast a talk over Noumea radio on the objects of the flight. At Noumea, also, the Catalina (which is on loan from the Australian Air Force) took on board 150 lb of mail for Tahiti, which was reached at 0217 hr G.M.T., on March 15th. Capt. Taylor hopes to reach Valparaiso, Chile, in three weeks, after calls at Samoa, Cook Island, Tahiti and Easter Island.

BREVITIES

ON March 13th a B.E.A. helicopter made the first proving flight for the London-Birmingham service which (as we reported last week) the Corporation is to open early in June. The technique of entering the London Control Zone and the radio coverage available along the route were investigated. The S-51 was flown by Capt. John Thielmann.

* * *

The first of the six Australian-built D.H. Drovers is now in operation on a T.A.A. feeder route. It has been named after Dr. Allan Vickers who, since 1931, has participated in the Queensland "flying doctor" service. The remaining Drovers will be named after other prominent figures in the service.

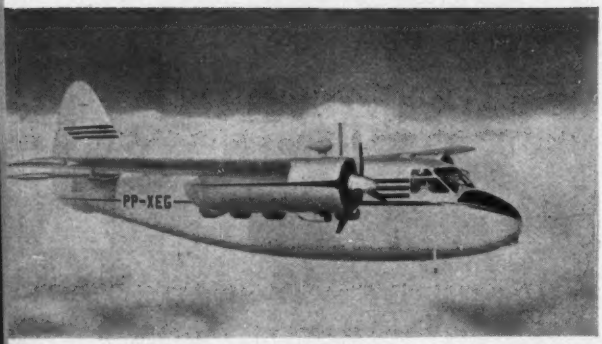
* * *

The first version of the French experimental C.M.88 Gemeaux, a light two-seater powered by two Turbomeca Piméné turbojets, is now awaiting favourable weather for making its first flight at Aire-sur-l'Adour. It will be used to carry out tests on wing profiles and turbojet installations.

* * *

Aer Lingus expect to operate as many as 900 scheduled flights per month between London and Dublin this summer—the largest number of services the company has ever been called upon to provide for passengers on this route. In August and September

MARATHON-VENDING: Following a demonstration flight by the Handley Page Marathon (reported on page 332), this group of interested parties and well-wishers posed before the machine. They are (from left to right) Mr. G. H. C. Lee (general manager, W.A.A.C.), Sir Herbert Walker (chairman, W.A.A.C.), Mrs. G. H. C. Lee, Major McCrindle (B.O.A.C.), Lady Walker and—guess who?



A MATTER OF PRECEDENCE: In the March 9th issue of "Flight" we published a photograph of the first Percival Prince Series III, which was stated to be the first of the fleet ordered by the Brazilian company, Aeronorte. In actual fact the delivery of the first Series III will constitute the second Prince which this company has received. Having flown to Brazil via the North Atlantic route last August, the first machine, a Series II (left) has been operating very successfully on that country's internal feeder routes.

CIVIL AVIATION . . .

"Starflights" will be made three times nightly and all cargo services will be flown three times a week. The Starflights, which proved popular last year, will be re-introduced in May with an initial frequency of once nightly.

* * *

"Great improvements," says the M.C.A., are being made this summer to the public enclosures at London Airport and Northolt. The actual dates on which they will be open to the public will be notified later.

* * *

Last week the Minister of Civil Aviation received a deputation representing residents in the South Harlington and Harmondsworth areas. The party discussed with Lord Pakenham many of the problems arising from the projected development of London Airport north of the Bath Road; these included the question of compensation for people displaced from their homes. Lord Pakenham undertook to give a full written reply to the residents' requests; it will eventually be published.

* * *

Since it first went into regular service last September, the S.O. 30 Bretagne operated by Iranian Airways has flown an average of 100 hours a month on the Paris-Teheran, Bombay-Teheran and Paris-Bombay services. In spite of the fact that these routes—which are long for an aircraft of this type—suffer severe extremes of climate and are noted for the difficult conditions under which maintenance is normally conducted, the operators are reported never to have had to interrupt their scheduled services. In North Africa two further Bretagnes are now in service with Air Algérie.

* * *

Satisfactory traffic statistics for 1950 are reported by Swissair. The total of passengers carried showed an increase of 25 per cent, while freight and mail rose by 36 per cent and 158 per cent respectively. These improvements were achieved with an increase of only 12 per cent in the capacity ton-kilometres offered. The excellent regularity figure of 99.5 per cent was reached. This favourable development of traffic has naturally had a beneficial effect on the company's financial position and the final result is now not expected to be nearly as unfavourable as was anticipated.

United Air Lines have now taken delivery of their first DC-6B. Powered by Pratt and Whitney R-2800 engines, the DC-6B is an improved version of the well-tried DC-6 and is characterized by its increased power and greater seating capacity; it cruises at over 300 m.p.h. and carries 58 passengers and 6,000 lb of cargo. Twenty of these machines have been ordered, at a cost of approximately $20,000,000.

* * *

The name of an Australian National Airways' pilot, Capt. Keith Virtue, is the latest addition to the select company of pilots who have logged more than 20,000 flying hours. Capt. Virtue, who is 42, is the first Australian pilot to have achieved this honour; he has been flying since the age of 18. During the last war he played a prominent part in the evacuation of civilians from New Guinea and in supply-dropping operations in other Pacific areas.

* * *

On March 14th the chairman of B.O.A.C., Sir Miles Thomas, cut the first sod on a new housing site at Heston, which will accommodate employees from London Airport. The scheme has been developed entirely by the British Airways Staff Housing Society, Ltd., and was deemed necessary so that air personnel in specialized occupations, who could not qualify for houses provided by the local authorities, would have some incentive to settle in the neighbourhood of the airport.

* * *

The new £4,000,000 Reunion National Airport at Durban will be used for the first time in August, when S.A.A. introduces Skymasters on the Johannesburg-Durban run. It will be the first of South Africa's three major post-war airports to go into operation; the others are located at Kempton Park and Capetown. S.A.S. will fly two Skymaster services a day between Palmietfontien and Reunion. At present five flights a day are made by Dakotas and Lodestars, which in August will be released for other duties throughout the Union.

* * *

It has been announced that Eastern Air Lines have contracted to purchase from the Glenn L. Martin company a further 25 Martin 4-0-4 twin-engined transports. This new order brings to 100 the total of 4-0-4s ordered to date. Eastern will have 60 of these aircraft and T.W.A. 40. The new order is said to have been made necessary by the rapid expansion of "defence-promoted" air travel within the United States, and has been undertaken at the request of the Civil Aeronautics Board and other Government agencies.

* * *

During the rescue work which followed the recent volcanic eruption of Mount Lamington in New Guinea, aircraft of the Qantas fleet, based at Lae, made a total of 260 flights and carried almost a million pounds of supplies and rescue equipment. Q.E.A. handled almost the entire evacuation of people from the stricken area and flew in all but a fraction of the rescue workers, together with food, vehicles, water, medical supplies and aviation and motor fuel. For the first week every available Qantas pilot was engaged on the operation and, in addition, ground staff based at Lae were flown to the Popendetta area to assist in giving first-aid to the natives, and to help in the loading of aircraft.

FORTHCOMING EVENTS

Mar.	24.	British Interplanetary Society: Film Show, Science Museum, London.
Mar.	28.	Royal Aero Club: Annual General Meeting.
Mar.	29.	R.Ae.S.: "Modern Naval Aircraft Design," by D. L. Hollis Williams, B.Sc., F.R.Ae.S.
Mar.	31.	Army v. R.A.F. Rugby, Twickenham.
Mar.	31.	R.A.F. College, Cranwell: Hockey v. R.M.A. Sandhurst (away).
Apr.	5.	R.Ae.C.: Film Show: *Pegasus, Air Beef* and *Supermarine.*
Apr.	6-10.	Physical Society: Exhibition, Imperial College, South Kensington, London, S.W.7.
Apr.	7.	British Interplanetary Society: "Evolution of Life in the Universe," by Prof. J. D. Bernal, F.R.S.
Apr.	10.	R.Ae.S. Section Lecture: "Simulators," by W. R. Thomas, B.Sc., A.M.I.E.E.
Apr.	12.	R.Ae.S.: "Comet Planning and Production Methods," by H. Povey, A.F.R.Ae.S.
Apr.	13.	College of Aeronautics, Cranfield: Senior Common Room Society's Annual Dinner.
Apr.	13.	R.F.C. and R.N.A.S. Second Reunion.
Apr.	26.	R.Ae.S.: Discussion: "Air Travel from the Passenger's Point of View."
Apr.	26.	R.Ae.C. Film Show: *Flying Club,* 1925-50, film and commentary by A. Graham Head, and *Eagles of the Fleet.*
Apr.	28.	Exeter Aero Club Rally.
Apr.	29.	First International Helicopter Competition, Italy.
May	5-8.	Foire de Paris Rally, Toussus-le-Noble.
May	12-13.	Isle of Wight Air Races.
May	12-14.	Aero-Club de France: Champagne Rally.
May	13-14.	S.M.A.E. International Model Competitions.
May	14.	S.S.A.F.A.: Air Display, Hucknall, Notts.
May	19.	Derby Aero Club: "At Home" and Flying Display.
May	20.	Kent Coast Flying Club: "At Home" (sponsored by A.B.A.C.).
May	26.	Newcastle-on-Tyne Air Display.
May	26.	Wolverhampton Aero Club: "At Home" and Goodyear Trophy Race.
June	2-4.	Yorkshire Aeroplane Club: International Rally.
June	8-10.	Air Circuit of Sicily.
June	9.	Rally and Race, Fairwood Common Aerodrome, Swansea.
June	10.	Lancashire Aero Club: "At Home" (sponsored by A.B.A.C.).
June	15-18.	Royal Danish Aero Club: International Rally.
June	16-17.	F.A.I. International Model Competitions.
June	16-17.	International Rally, Flers, France.
June	16-17.	Boston Aero Club: Rally.
June	23.	R.Ae.C.: Festival of Britain National Air Races, Hatfield.
June	24.	Northern Heights Model Flying Club: Gala Day and Queen's Cup Contest, Langley Airfield.
July	1.	Paris Aero Show.

CIVIL AVIATION . . .

CLUB AND GLIDING NEWS

ULTRA-LIGHT-AIRCRAFT enthusiasts will be glad to hear of the good progress being made in converting the Coventry Victor Neptune 1½-litre flat-four engine for U.L.A.A. purposes.

Undertaken purely as a private venture, which has involved the expenditure of several thousand pounds, the new unit is actually a re-design of the standard Neptune, which has been well proven in various industrial applications, such as the driving of compressors and generators.

The basic specification to which Major A. W. Weaver, head of the Coventry Victor Motor Co., Ltd., was asked to produce this power unit required that it should develop about 40 b.h.p., be cheap, simple, robust and easy to service, weigh as little as possible and, at the same time, be capable of making use of standard Neptune components. On investigation it was found that neither the standard crankcase nor crankshaft could be used, and, to carry the airscrew thrust and journal bearings efficiently, a completely new crankcase had to be designed.

Major Weaver hopes to have the new engine assembled towards the end of this month. It is expected that subsequent versions may be developed to give 50 b.h.p. for a weight of about 140 lb.

DURING February total flying recorded by the Wiltshire School of Flying, which operates from Thruxton airfield, near Andover, amounted to 86 hr, bringing the total since January 1st to 276 hr. Over the corresponding period in 1950 the total was 246 hr, so that, in spite of the wettest February on record, the club actually increased its average for this time of year.

All the W.S.C.'s Austers, together with those of the Royal Artillery Flying Club, have now undergone their annual overhauls, and two additional Tigers are in commission. These latter machines, incidentally, are being fitted with landing lights, to comply with new night-flying regulations and, having carried out a considerable amount of research into the problem of providing the necessary modifications at minimum cost, the W.S.C. will be glad to assist any other interested clubs.

The target of five C.s of A. a month on privately owned aircraft is still being kept up and the workshops are also rebuilding a batch of 12 Tiger Moths; a further 14 are to follow.

Alterations and additions to the club-house and kitchen have now been completed.

The annual race for the Thruxton Cup, which will be flown over the same course as last year (from Thruxton to Totland Bay, Isle of Wight, and back), will be held this year on August 19th.

AFTER a particularly trying winter the Derby Aero Club is now looking forward to the return of better flying weather and a number of plans have been made for visits to the Continent. The club expects to be well represented at meetings during the coming season.

D.A.C.'s chief flying instructor, F/L. M. Mallorie, has of late been kept busy with the training of six A.T.C. cadets, two of whom, by taking every advantage of the few available flying days, have already qualified for their Private Pilots' Licences.

One of the club's private pilots has now, with the recent acquisition of an Autocrat, graduated to the rank of private owner.

During the slack flying months the Engineering Section has been busy on overhauls and Cs. of A., 15 aircraft having actually gone through the shops.

The club was recently pleased to welcome a party from the Leicestershire Aero Club, and a return visit by a contingent from Derby was paid on their official opening night. It is hoped that these events represent the beginnings of many more inter-club visits and should help to foster the popularity of the private flying movement in the Midlands.

A fancy-dress dance is being held in the club-house on March 31st; in the programme, it is rumoured, a "rather startling" cabaret item is likely to be included.

NEWCOMER: Built on conventional but pleasing lines, this three-seater M.B.100, which recently flew for the first time, is the tenth prototype produced by the French firm of Avions Maurice Brochet. Its design is intended to fulfil the three primary requirements of safety, comfort and economy. Powered by a 90 h.p. Hirth, the aircraft cruises at 140 km/hr and has a radius of action of 600 km.

IN looking back on the year 1950, the members of the Rochester Flying Club, based at the airfield of the same name, can congratulate themselves on several notable successes. One member, E. Day, won the King's Cup and another, F/L. P. Raymond, attained third place in the *Daily Express* race. In all, the club's aircraft logged over 2,000 hours' flying.

Five Indian students gained their Commercial Licences—one was only 19½ years old and had started to fly in June of 1950. Twenty-five Private Pilots' Licences were awarded during the year and a similar number were renewed. A number of A.T.C. cadets were also trained to the same standard.

Aircraft now used by the Rochester club are Austers, Tiger Moths, Magisters, a Proctor and a Consul.

The club's secretary, Mr. D. S. Robbins, may be contacted at Bluebell Hill 212-3.

SOME preliminary details are now available of the intended gliding expedition which is being planned by the R.A.F. Gliding and Soaring Association to St. Auban, France.

One of the primary objects is to obtain as much information as possible on the standing wave which is known to exist at St. Auban and, on returning to the United Kingdom, to apply that knowledge to a subsequent exploration of similar phenomena in the United Kingdom, notably the Helm Wave. The R.A.F.G.S.A. is of the opinion that there may be some connection between high-altitude standing waves and high-altitude gusts, and it is thought that the sailplane is a suitable instrument for investigating such phenomena.

The expedition will use its own machine and has been loaned suitable recording instruments for the task. The personnel are all members of the Association and include G/C. G. J. C. Paul, D.F.C. (chairman), W/C. W. H. Ingle, A.F.C., and F/L. H. Neubroch (both holders of the Silver "C" certificate) and S/L. A. R. Williams. When the expedition is under way other members of the Association will join it for shorter periods.

In order to keep expenditure to a minimum the party is making use of tents and a towing vehicle for accommodation, and the whole expedition is, in fact, a completely self-contained mobile unit. The party was due to leave the United Kingdom on March 19th.

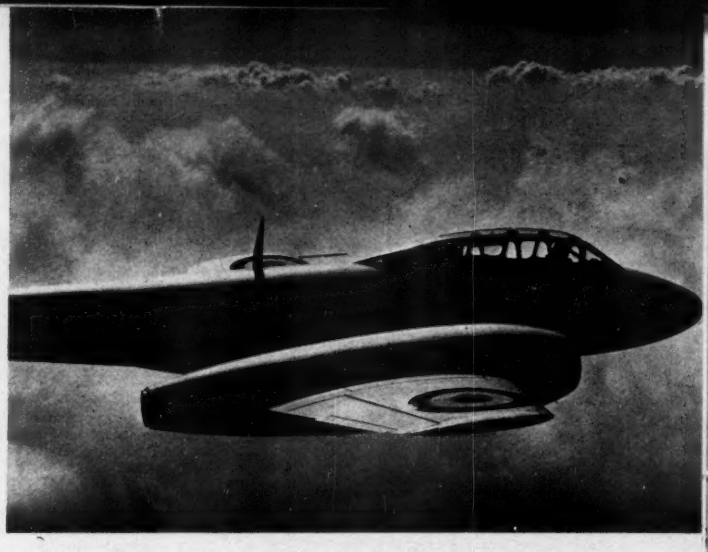
GLIDING news comes this week from Poland, where the year 1950 is reported to have been outstandingly successful. In addition to meeting in the spring and summer, a winter camp was held at Jésów during the first half of December, at which several notable flights resulted in the breaking of national records. A number of pilots also completed the test for their Gold "C" certificates.

Some creditable flights of approximately 6,000 metres were made, while one pilot, Józef Jacek Figwer, eventually reached an absolute height of 7,950 m, thus qualifying for a diamond badge and breaking the Polish national record for gain of height and for absolute altitude in single-seat gliders; his gain was actually 5,700 m. Later, however, even this record was beaten by Adam Niznik, who gained 6,800 m and attained an absolute height of 8,500 m. (For this performance Niznik was awarded a diamond badge.) Even this record did not stand for long, however, being beaten by Andrzej Brzuska, who gained 7,500 m and reached an absolute height of 8,750 m.

Two other flights for which the pilots were awarded "diamonds" were 7,940 and 7,200 m respectively; neither of them used oxygen. The Polish results are all the more remarkable in that they were achieved in what is normally regarded as the closed season for gliding.

SERVICE AVIATION

Royal Air Force and Naval Aviation News



"Flight" photograph

TOP-RUNG TRAINER: By far the fastest of our military trainers is the Gloster Meteor T.7 (two Rolls-Royce Derwents). One of these tandem-two-seaters is seen cruising at 500 m.p.h. or so in sparkling sunshine.

THE Air Ministry announces the following Royal Air Force appointments, to take effect in May :—

A.V-M. Richard Llewellyn Roger Atcherley, C.B., C.B.E., A.F.C., to be Air Officer Commanding, No. 12 Group, Fighter Command.

A.V-M. Gilbert Edward Nicholetts, C.B., A.F.C., to be Senior Air Staff Officer, Coastal Command.

A.V-M. Atcherley has been Commander-in-Chief of the Royal Pakistan Air Force since February, 1949, and was formerly Commandant of the R.A.F. College, Cranwell, from September, 1945. At the beginning of the last war he commanded No. 219 (Night Fighter) Squadron, and in 1940 was garrison commander of a small fighter force based near Narvik, Norway, during the German invasion of that country. In 1941-42 he commanded fighter stations at Fairwood Common and Kenley, Surrey, and early in 1943 became Air Officer Commanding, No. 211 Group, D.A.F. In 1944, he formed the R.A.F. Central Fighter Establishment at West Raynham, Norfolk, and commanded it until he left for Cranwell. Twin brother of A.V-M. D. F. W. Atcherley, at present Senior Air Staff Officer, Fighter Command, he was born at York on January 12th, 1904, and educated at Oundle School and the R.A.F. College, Cranwell, from which he was commissioned in 1924. He was a member of the winning Schneider Trophy team in 1929 and in the same year won the King's Cup Air Race.

A.V-M. Nicholetts has been Director of Organization at the Air Ministry since October, 1948, and formerly commanded the R.A.F. Central Photographic Establishment for two years. At the outbreak of war in 1939 he was at the Air Ministry in the Directorate of Organization, but was soon afterwards given command of No. 228 Squadron, with which he went to the Middle East in 1940. In 1941 he was an Air Staff Officer at R.A.F. Headquarters, Palestine and Transjordan, and later that year commanded the R.A.F. Station at Haifa. Early in 1942 he was sent to the Far East and was captured by the Japanese.

Born at Brampton, Devon, in November, 1902, and educated at the Royal Naval Colleges at Osborne and Dartmouth, he became a cadet at the R.A.F. College, Cranwell, in 1921, and was commissioned in the following year. In February, 1933, as a flight lieutenant, he and the late S/L. O. R. Gayford, in a specially built Fairey long-range monoplane, flew from Cranwell to Walvis Bay, South-West Africa (5,341 miles) in 57 hr. 25 min, establishing a new world long-distance record.

"Give Us More Shackletons"

AIR MARSHAL Sir Charles R. Steele, K.C.B., D.F.C., A.O.C.-in-C., Coastal Command, addressing workers at the Woodford (Cheshire) factory of A. V. Roe and Co., Ltd., on March 15th, said, "The Shackleton is an aeroplane we want. It can carry everything we want. Give us more Shackletons." Air Marshal Steele saw full-scale production of the type, and the first squadrons should be equipped with these long-range maritime-reconnaissance aircraft in the immediate future.

The Queen with her Squadron

AS Honorary Air Commodore of No. 600 (City of London) Squadron, Royal Auxiliary Air Force, Her Majesty the Queen dined with the Squadron at their London headquarters (Finsbury Barracks, City Road, E.) on March 14th. The occasion was one of the fortnightly dining-in nights in the mess, and Her Majesty sat down to dinner with 18 officers of the squadron and a number of guests. She was received by the Commanding Officer, S/L. J. P. Meadows, D.F.C., and by the mess president, F/L. K. N. Haselwood. The guests included A. Cdre. Finlay Crerar, C.B.E., and W/C. A. Donaldson.

Princesses for Transport Command

DEFINITE confirmation of the proposed military use of the Saunders-Roe Princess flying-boats was given by the Air Minister, Mr. Henderson, on March 14th. He stated that the Princesses—each of which had "the equivalent capacity of one squadron of Hastings"—would be handed over to Transport Command on completion. The first of the boats is due to fly later this year; the last will be completed in 1953.

Canopy for Casualties

TO give protection from sun or rain to patients being unloaded from casualty evacuation aircraft, a mobile ramp is now in use at R.A.F. Station, Negombo, Ceylon. The ramp, so far the only one of its kind, provides a covered gangway enabling the patients to be moved from the aircraft into the waiting ambulances

"Flight" photograph

FAIREY-LIGHT TOUCHDOWN: A Fairey Firefly 4 settles comfortably on the deck of H.M.S. "Theseus." For anti-submarine duties a new (three-seater) version of the Firefly is now under development.

without being brought into the open. It was designed and constructed by members of the motor transport repair and servicing flight at the station. Apart from the protection given, the ramp also helps to speed up the work of unloading. Thirteen stretcher cases and 15 sitting cases from Korea were recently moved from the aircraft into the ambulance in 20 minutes, and within 30 minutes of the aircraft's arrival all the cases were in the R.A.F. Hospital, Negombo, which they left on the following morning on the next stage of their homeward journey.

Wings Parade at Ternhill

PILOTS successfully completing the present course at No. 6 Flying Training School, Ternhill, Salop, will receive their "wings" at a graduation parade to be held at the school on March 28th, when the reviewing officer will be A.V-M. T. G. Pike, C.B., C.B.E., D.F.C., A.O.C. No. 11 Group, Fighter Command.

New C.O. for St. Athan

FORMERLY Command Engineer Officer at H.Q., M.E.A.F., G/C. John Mutch, C.B.E., has succeeded A. Cdre. H. E. Forrow, C.B., O.B.E., as commanding officer of R.A.F. Station, St. Athan. He takes up the acting rank of Air Commodore with the new appointment. Born in March, 1907, A. Cdre. Mutch entered the R.A.F. as an apprentice at the age of 15½, later being selected for a cadetship at the R.A.F. College, Cranwell.

Improved Recruiting

AT a luncheon on March 13th, given by the Lord Mayor of Sheffield to mark the tenth anniversary of the A.T.C. in that city, Mr. Arthur Henderson, Secretary of State for Air, said that once more we had a balanced air force. Recruiting for the regular Service was much better than it had been, and over the last six months regular intakes had increased more than three times compared with the previous six months. The regular content was now 63 per cent and should rise to 70 per cent by the end of the year. Concerning Russian air strength, Mr. Henderson said that, so far as there was any evidence, it seemed clear that to-day it was about 80 per cent of what it was in 1945. It was no secret, he observed, that the R.A.F., over the same period, in terms of manpower had been reduced by 80 per cent, though it was now steadily increasing again.

ETON AT FELTWELL: Fourteen boys of the Eton College A.T.C. recently visited Feltwell, Norfolk, where they studied the pilot-training syllabus. They are seen inspecting a Percival Prentice.

Indian Air/Sea Exercises

AN air-sea exercise recently took place off the west coast of India between destroyers, frigates and minesweepers of the Indian Navy, and Lancasters of Coastal Command, temporarily based at Negombo, Ceylon. The exercise lasted four days and was the first in which Ceylon-based aircraft have co-operated with the Indian Navy.

The purpose of the exercise was twofold. It provided an opportunity for R.A.F. aircraft to test their procedure in tropical waters, and it gave the ships' companies an insight into possibilities of their being followed by an invisible enemy, who would eventually direct a striking force of aircraft on to their position. During the exercise two R.A.F. officers, one from the Lancaster squadron and one from Air Headquarters, Ceylon, were detached to the Naval Headquarters, Cochin, for liaison duties.

The five Lancasters were in the air for approximately 100 hours during the four days and flew some 16,000 nautical miles. They received a warm welcome at the Indian Air Force station at Bangalore, where they refuelled.

REFUELLING: Corned-beef fritters are served during a recent exercise by the R.A.F. Mountain Rescue team at Edzell airfield, Scotland. One of these exercises is held every week, and all members of the team are volunteers.

W.R.A.F. Markswomen

THE Women's Inter-Services annual small-bore match, shot shoulder-to-shoulder at Uxbridge on March 5th, was won by a W.R.A.F. team captained by Sq/O. A. D. Maurice. Out of a possible score of 1,600, the W.R.A.F. eight scored 1,544; the W.R.N.S. were second with 1,526, and the W.R.A.C. scored 1,489.

Highest individual scorers were 1st Off. Foster-Hall of the W.R.N.S., Cpl. Rea, W.R.A.F., and Wren Slack, who tied with 197 out of 200. Wren Slack won the individual trophy for highest score by gaining 99 out of 100 in the tie-shoot.

Trophies were presented by the Director of the W.R.A.F., Air Chief Commandant Nancy Salmon, O.B.E., A.D.C.

R.A.F.A. Progress

FOUR outposts in the United States—at St. Louis, Chicago, Seattle and New York—were among 62 new branches formed by the Royal Air Forces Association during 1950. This is announced by the president of the R.A.F.A., Air Marshal Sir Robert Saundby, in his foreword to the annual report. With 778 branches throughout the world, the Association is now well in sight of its target of 1,000. Many former members of the R.A.F. and W.A.A.F., 60 per cent of whom did not belong to the R.A.F.A., were assisted during the year. Over 1,000 pension cases were handled—614 with successful results.

This year the Association will celebrate its coming-of-age; accordingly, a draft petition for a royal charter has been prepared and will be submitted to the King.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Inherent Stability

WITH reference to the article "Infallible Glider" in *Flight* of March 9th, 1951, the following may be of interest. The late Robert Kronfeld, in his book *Kronfeld on Gliding and Soaring*, quotes Etrich (of Taube fame) as follows:

"We, too, were prepared to learn from Nature. We studied the flight of birds and even enlisted as teachers two living vampire bats. Among my father's many books on flying we found a work by Prof. Ahlborn, of Hamburg, on *The Stability of Kite-like Planes*. In this work the investigator drew attention to the flying seeds of a Javanese palm, *Zanonia Macrocarpa*, which can cover wide distances.

"We regarded this phenomenon as a signpost of Nature. We made paper models, increasing their size as we gained experience. In 1904 a big model of a gliding machine, carrying a load of 56 lb, made quite considerable flights. A year later we designed a large machine with a span of 40ft, which was completed in the following year. Started from a rail trolley and carrying a bag of sand it flew down into the valley in beautiful, calm gliding flight, and landed smoothly without any artificial steering, a thousand feet from its starting point.

"How was this possible without any steering gear? The chief peculiarity of the flying seed is that its wings have a pronounced backward and upward curve. The action of the *Zanonia's* surface is therefore the same as that produced by the combined effect of a wing and a stabilizing plane. The typical feature of my flying machine was that it consisted of nothing but carrying surfaces, which were nevertheless stable."

Grangetown, Sunderland. J. T. ROBSON.

Navigation Aids

I SHOULD like to reply to the latest letter (March 9th) from Mr. W. Gregson, on the subject of the Decca Flight Log *versus* V.O.R./D.M.E. I believe he is aware that one of the best-qualified American companies has been engaged for a considerable time on the development of a map presentation for V.O.R./D.M.E. This rather disproves the statement that "it is quite simple . . ." and also shows that it is doubtful if the consensus of opinion, even in the U.S.A., is today in favour of a course-and-distance indicator.

As I understand that Mr. Gregson is attending the Montreal I.A.T.A. Convention (Radio Aids Group), he should also be familiar with the following extract from the M.C.A. report on the experimental Flight Log which has been submitted to that Convention by B.E.A. :—

". . . it has been shown that, when using the Flight Log, the execution of holding patterns; take-offs and flights to defined outbound points; controlled departures from specified holding points along defined paths to a second defined point; straight-in approaches from arbitrarily defined points; and *en-route* navigational flights—can be performed with a higher standard of flexibility and precision than is possible with any other known pilot-presented navigational aid in civil use."

The map presentation of V.O.R./D.M.E. information could not be any more accurate than that permitted by defects in the basic system. Furthermore, presentation of a course-to-steer and distance-to-go is useful only when the information is given from the point to which you want to go. In Europe and in America, flights are rarely a question of going straight from one place to another. In the busier areas, they have to conform to a flight pattern which, as in the case of London, Paris and New York, can be followed most satisfactorily by a map presentation.

Obviously there is no space to go into a detailed analysis of the voluminous A.I.L. report, but my comments on Mr. Gregson's points are : (1) Calibration of error is believed to be impractical as well as inconvenient, e.g., correction cards for each V.O.R. would not be welcomed by pilots; and altering the nominal alignment of an airway to conceal the inaccuracy in the V.O.R. concerned would raise great difficulties if that V.O.R. went unserviceable and the stand-by beacon, having a different error, had to be brought into operation instead, naturally at the shortest notice. (2) The receiver in question was the best available and very expensive, contrasting with the claimed advantages of being able to use cheap equipment with V.O.R. Furthermore, the results were obtained under the carefully regulated conditions to a scale and scientific survey and such serviceability could not be reasonably expected in day-to-day commercial operations; (3) this statement is strictly true, but begs the question, since the errors that remain long enough to affect the aircraft's track are serious.

The statement from a reader of your paper that four-course M.F. ranges should suffice for some years is astounding. It completely overlooks the justified publicity you have given to the splendid performance of the Comet and the Viscount, whose long periods of ascent and descent will require lateral separation to be applied on a scale completely beyond the scope of four-course ranges. The statement belittling the need for accuracy of the *en-route* navigation aid not only ignores this point also but overlooks the fact that in a congested air space of parts of Europe, particularly the U.K., civil aircraft must keep accurately within air space intended to protect them from non-controlled flying and such other factors as danger areas.

As mentioned previously, the Track Guide and the Integrated Track Range are about to be tested and discussions of their detailed performance should obviously await results of these trials. However, it is worth pointing out to Mr. Gregson that the Track Guide will not give a homing bearing like A.D.F. but a track line which is highly preferable from the point of view of navigation and descent from altitude. Decca trials have been carried out in the highest-noise zones of South Africa and Borneo and I can assure Mr. Gregson that there will be no difficulty in locking the distant slave.

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Competitive Trials

RECENT competitive trials, between the two anti-submarine prototypes built respectively by the Fairey Aviation Company and Blackburn and General Aircraft, raise the interesting problem of how an aircraft may be fairly assessed in such circumstances. What, for instance, constitutes an ideal formula for differentiating between similar aircraft which have been designed to satisfy the same specification?

Let us assume that we have any two Naval prototypes which have undergone the protracted programme of contractors' flight trials, assessment by the A. and A.E.E. and/or R.A.E., deck-landing tests, operational trials, maintenance conferences, etc. At the conclusion of this period, which does in fact occupy many months, the aircraft should not only fulfil but excel the requirements of the Admiralty. One machine will, of course, be a little better here and the other will gain a little there, but on the whole the two machines will have progressed very much in parallel.

But how is it decided which is the better of the two and, hence, which shall be produced for the Navy? There are many features which must influence the decision, and for the sake of clarity the suggested eight salient features may be tabulated thus :—

(a) *Flying Qualities.*—General handling, stability, performance, etc.
(b) *Take-off Performance.*—Length of run, directional control, etc.
(c) *Landing Performance.*—View, undercarriage shock-absorption, flying controls, etc.
(d) *Operational Trials.*—Assessment on actual service trials.
(e) *Maintenance.*—Engine, airframe, inspection, interchangeability, etc.
(f) *Crew Comfort.*—Grouping and accessibility of instruments and other equipment.
(g) *Development Possibilities.*—Incorporation of bigger and better weapons and more and more equipment (as usually occurs in Naval Aviation!).
(h) *Production.*—Simplicity of production, costs, availability of labour, and allied factors.

Having decided on the main features, the question of assessing their individual values is the next problem—is a machine with 100 per cent flying qualities but only 90 per cent in maintenance features of greater war potential than one which gains 100 per cent for maintenance and 90 per cent for flying qualities? Or do well-designed crew compartments outweigh good view and responsive controls for deck landing?

In order to provide a target at which aeronautical experts can shoot, some suggested marks for the various features of our imaginary Naval prototypes are set out below and they are so arranged that an ideal aircraft would score a total of one hundred:—

(a) Flying Qualities, 22.
(b) Take-off Performance, 8.
(c) Landing Performance, 12.
(d) Operational Trials, 18.
(e) Maintenance, 15.
(f) Crew Comfort, 11.
(g) Development Possibilities, 9.
(h) Production, 5.

Now within these classifications the same problem arises : what values are to be allocated to the various features? For instance, in the 22 marks for flying qualities, how many does one deduct for longitudinal instability, ailerons that heavy-up in a dive, or a vicious stall? Alternatively, does access to the power unit count more in the maintenance evaluation than the fact that the hydraulic components are hidden in some remote corner? Some expert opinions would be welcome.

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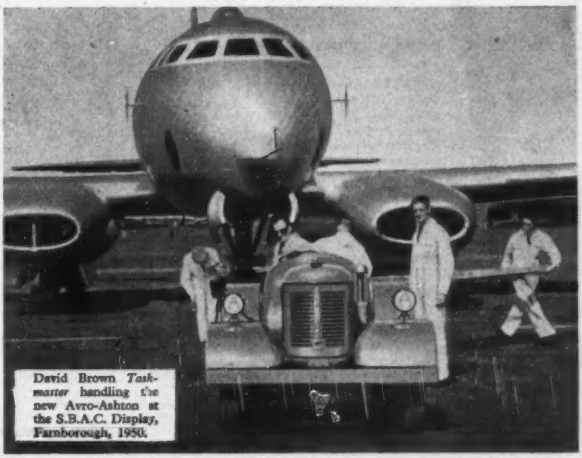

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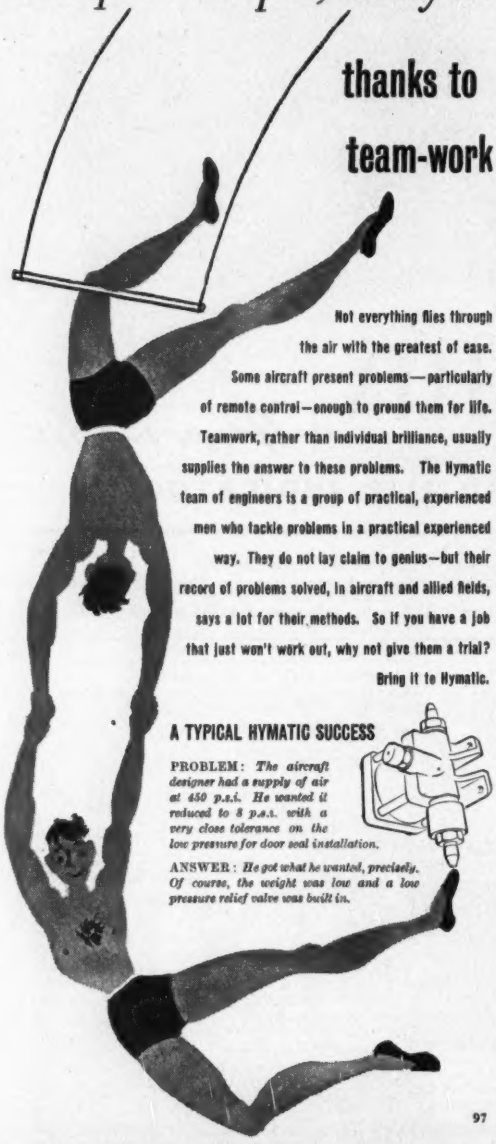

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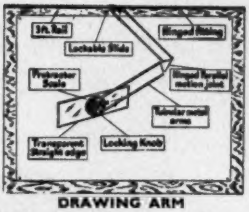

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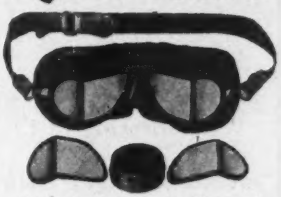

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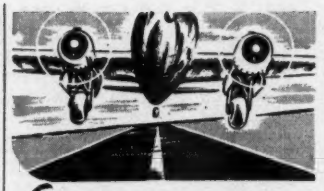

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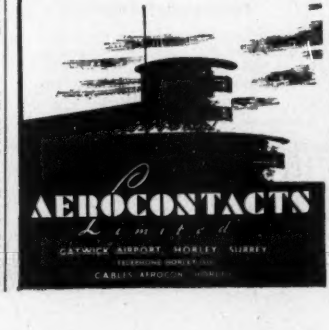

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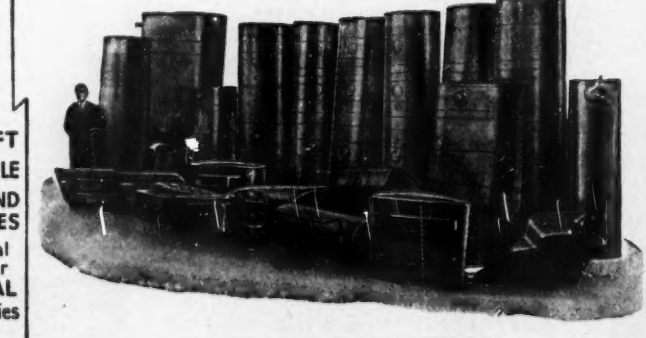

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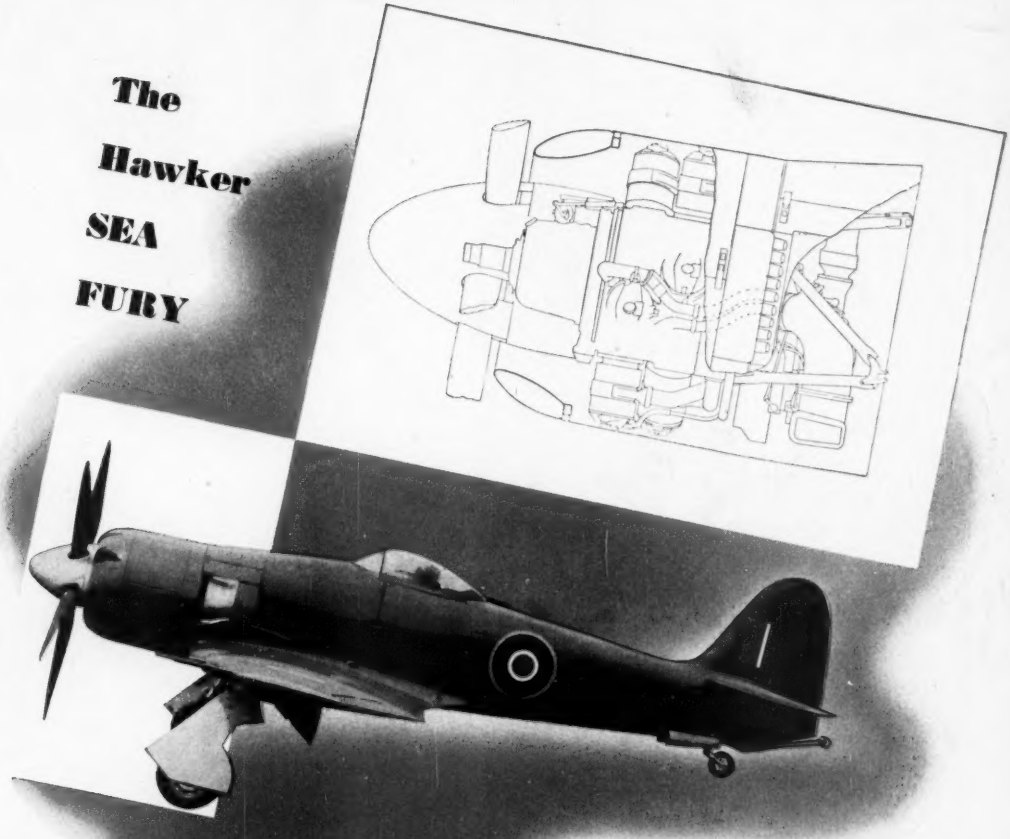

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